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Note the new, compact G-E oil-immersed magnetic switch also used in this installation. It is both explosion-proof and corrosion-resisting. The special coils, contacts, and relay are completely immersed in oil, which protects them from corrosive gases. The entire switch is housed in a heavy, cast-iron, explosion-proof tank. Inspection of the switch is an unusually simple matter. The switch is mounted directly on the cover; for inspection, all that is necessary is merely to remove the cover bolts and lower the tank.

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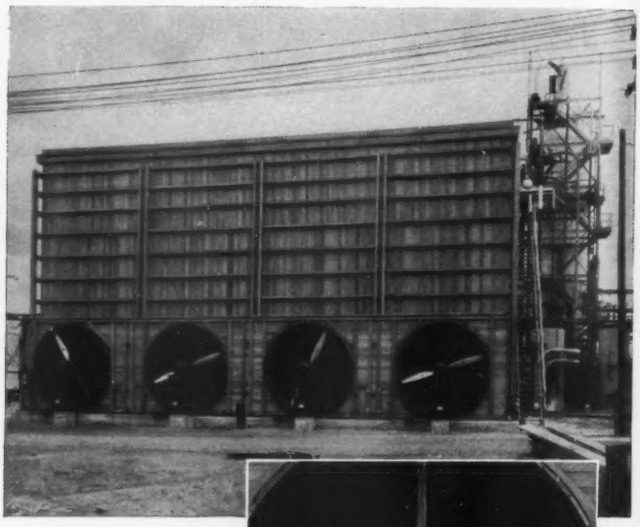
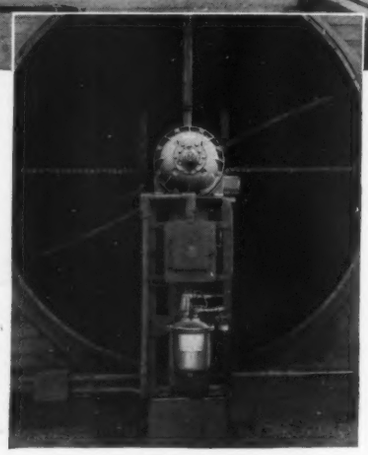
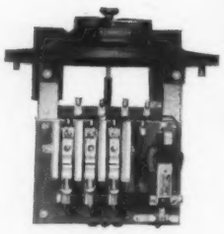


Four G-E explosion-proof motors and controllers operating large fans in the cooling tower. These motors are tested, listed, and approved by the Underwriters' Laboratories for use in Class I, Group D, locations



A close-up view of one of the four G-E explosion-proof motors and controllers used in the above cooling tower. Note the simplicity and compactness of this installation



The new CR-7006 oil-immersed magnetic switch. Oil-immersed push-button stations of similar construction are available. General Electric also makes explosion-proof air-break controllers for either manual or magnetic operation. All G-E explosion-proof controllers are built to the standards of the Underwriters' Laboratories and are fully tested for use in Class I, Group D, locations. Write for a copy of our Bulletin GEA-1588A, on G-E oil-immersed, explosion-proof control

200-720H

GENERAL ELECTRIC

REFINER
AND NATURAL GASOLINE MANUFACTURER

OCTOBER, 1933
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REFINER
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VOLUME 12, No. 10 OCTOBER, 1933

One Man Control

IF the petroleum code is to be successful there must be but one control board and only one hand at the control. That is the scale under which it was set up. Those at the sub-stations must do the bidding of the control room. Washington is the location of the control board and the planning and coordination committee is the hand at the control.

The design of the control system may be imperfect. The hand may pull the wrong switch. But these are not propositions for the moment. The spirit of the personnel of the industry as well as the personnel of conservation bodies should be to follow instructions in order to determine the perfectness of the petroleum code as well as the competency of the planning and coordination committee. So far there have been price increases and production declines, two objects sought under the National Industrial Recovery Act.

Despite this the man power at one sub-station deserted its post when members of the Texas Railroad Commission scampered off to Washington to guide the hand at the control board. Recently oil producers and members of the Oklahoma Corporation Commission have indicated a determination to besiege Washington in numbers to protest about the crude oil output granted to the state. Kansas and some others likewise are dissatisfied.

For four years the petroleum industry sought production control through state conservation groups. That was a farce. The federal government was asked to undertake the task. It has had some success, which places the petroleum industry and the conservation commissions in a sorry light when they seek to have the will within the states interfere with a program that is working. If state control was futile for four years, why expect its influence to be beneficial on a national program?

The basis of complaint has been that crude oil buyers in these states would buy more oil than the hand at Washington allocated to each state. That these buyers would buy the oil is not to be doubted.

But oil producers, refiners and conservation officials should read the provisions of the petroleum code. It provides that crude oil output should be determined by the consumption of gasoline and other products and that this consumption shall be determined by one group in Washington. After ascertaining what amount of crude oil is essential for furnishing these products, that shall become the total output for a month and the total allocated to the several states after calculations in Washington.

Nothing in the code gives a hint that crude oil production shall be guided by the amount of oil purchasers will accept in the fields. At times that amount might be in excess of current requirements as determined by consumption; at other times the oil wanted by purchasers might be less than requirements as determined by consumption.

To be sure NRA and the petroleum code have hampered the style of the petroleum industry as well as conservation commissions. But both the industry and the officials went to Washington seeking federal control. Now that it exists fair play demands that the method be given a trial.

So far trips to Washington and threats of mass meetings have not caused the hand in Washington to falter. While the states were pleading for more oil the allocation for October was reduced.

Heat Flow Diagram of Cracking Still

G. VANDENBERG, M. E.

CRACKING in commercial plants occurs largely above the critical pressure-temperature line. The accompanying Cox chart, Figure 1, in which the critical points curve is introduced, according to Wilson & Bahlke and the Van der Waals formula, indicates this clearly.

At or above this line, no heat of vaporization is consumed. A liquid, heated under critical pressure, will gradually expand to the vapor volume, consuming only sensible heat. At the critical temperature it is considered a vapor, requiring for its existance less heat than below the critical line. Reducing the pressure of this vapor, results in partial liquefaction. (Steam at the critical pressure of 3300 pounds has a heat content of 900 B.t.u., while steam of 330 pounds requires 1202 B.t.u.; thus, reducing the pressure from 3300 to 330 pounds results in partial condensation). Adding more heat to a vapor on the critical line, by raising its temperature, converts it into a superheated vapor or gas.

According to Table 16 of Bureau of Standards, Bulletin No. 97, "Thermal Properties of Petroleum Products," a 25° A.P.I. oil, heated to 800°F. at the critical pressure of 350 pounds, will consume an amount of sensible heat of 3502 B.t.u.; meanwhile it has changed into an actual vapor. The same vapor of 800°F. would require 3827 B.t.u., (Table 17) to exist as vapor at about 35 pounds and therefore a certain amount would return to the liquid phase, when the pressure is released.

The amount of heat in hydrocarbons, when leaving the coils of the projected cracking still, is calculated as follows:

Sensible heat up to 800°F., per gallon =	3502 B.t.u.
Superheat to 900°F., 100 x 7.53 x .75 =	565 B.t.u.
	4067 B.t.u. above 32°F.

or 3976 B.t.u. per gallon, above 60°F.

Heat calculations in this region are merely an approximation, as research in this field is incomplete. For instance, the specific heat for superheated steam is constant; .55 for all pressures and temperatures. For hydrocarbons in the gaseous state, the specific heat is probably constant, or almost constant; yet the Fortsch and Whitman formula calls for rather wide variation, due to temperature and gravity.

The Heat Flow Diagram Figure 2, shows the interrelation of the whole process and as it deals with thermo-dynamics, only the physical side is treated. The heat balance is given step by step, for every

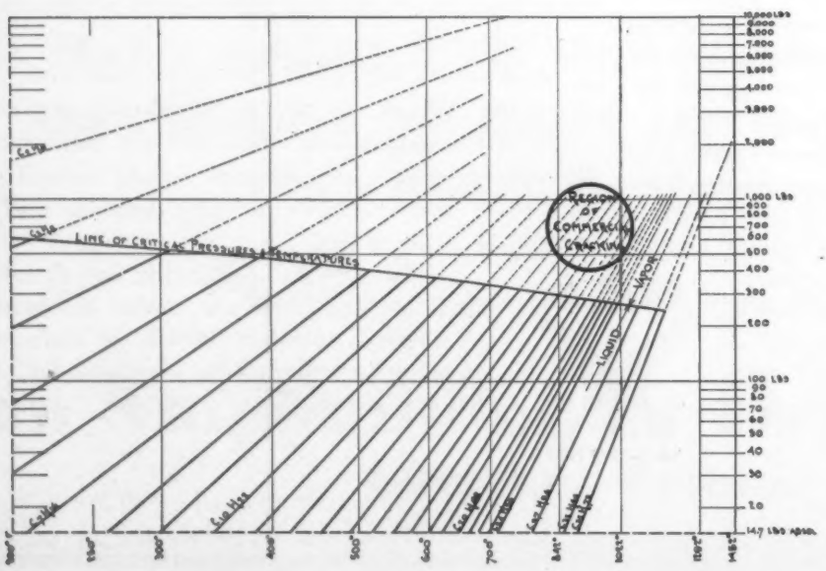
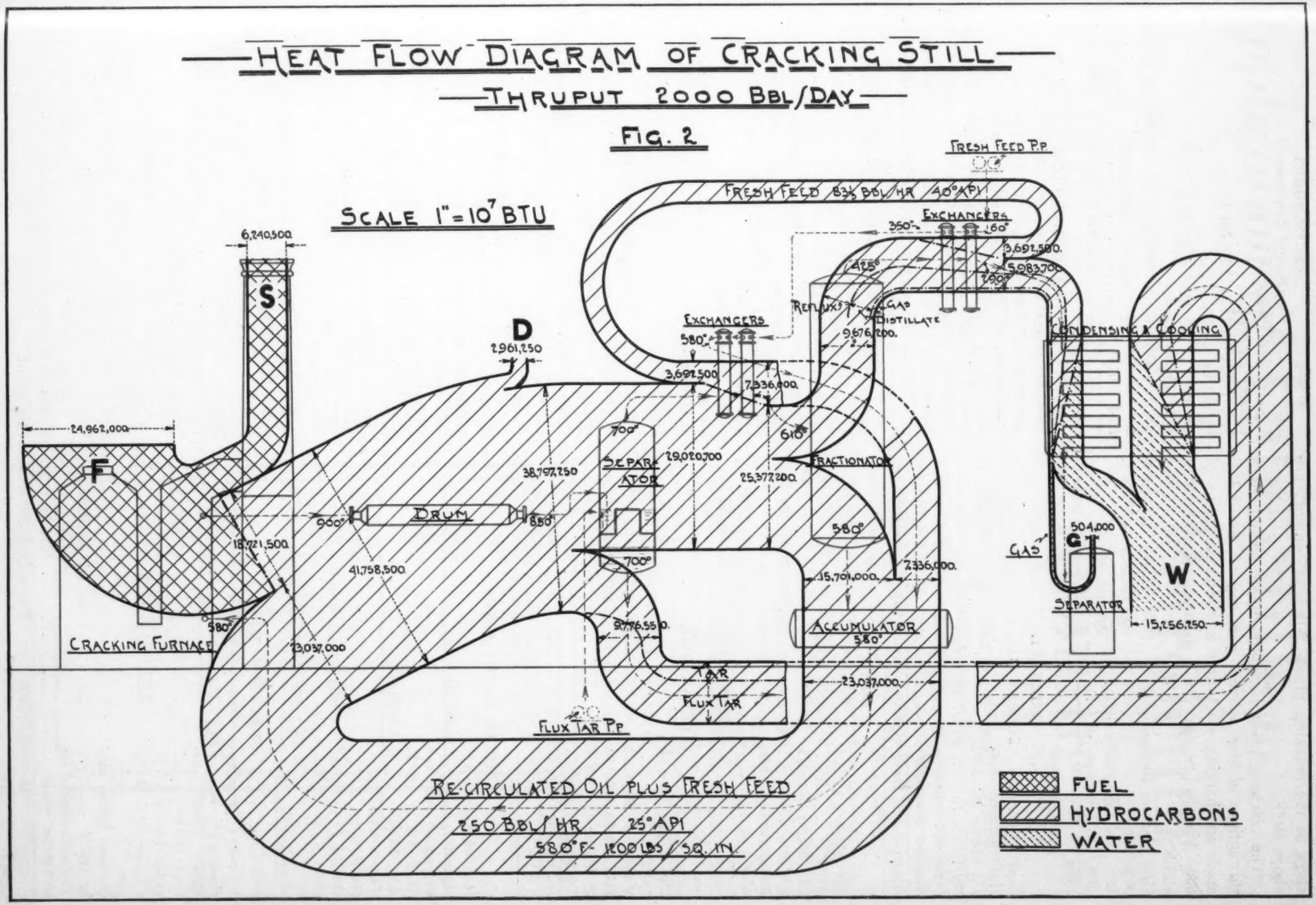


FIGURE 1
Cox Vapor Pressure Chart with relation to cracking conditions

HEAT FLOW DIAGRAM OF CRACKING STILL

THRUPUT 2000 BBL/DAY

FIG. 2



stage of the cracking plant. All heat contents are above 60°F.

The cracking plant is arbitrarily projected for a throughput of 2000 barrels per day of 40° A.P.I. made-up charging stock and a circulation rate of 6000 barrels per day. It is assumed that the still yields:

55% Pressure distillate	=	1100 bbl./day	54° A.P.I.
30% Tar	=	600 bbl./day	12° A.P.I.
12% Gas (non-condensible)	=	300 bbl./day	
3% Gas (unaccounted for)			
100%	=	2000 bbl./day	

FURNACE

Fuel . . . . . 24,962,000 B.t.u.
Hot charging stock
250 bbl/hr 25° API
580°F. . . . . 23,037,000 B.t.u.
Stack and other losses . . . . . 6,240,500 B.t.u.
Cracked stock 900°F. . . . . 41,758,500 B.t.u.

In = 47,999,000 B.t.u. Out = 47,999,000 B.t.u.

DRUM

250 bbl/hr stock
900°F. . . . . 41,758,500 B.t.u.
250 bbl/hr stock
850°F. . . . . 38,797,250 B.t.u.
Radiation or otherwise . . . . . 2,961,250 B.t.u.

In = 41,758,500 B.t.u. Out = 41,758,500 B.t.u.

SEPARATOR

250 bbl/hr stock
850°F. . . . . 38,797,250 B.t.u.
Vapors overhead
225 bbl/hr 700°F. . . . . 29,020,700 B.t.u.
25 bbl/hr tar 700°F. . . . . 3,112,200 B.t.u.
To be dissipated by
53.5 bbl/hr flux tar . . . . . 6,664,350 B.t.u.

In = 38,797,250 B.t.u. Out = 38,797,250 B.t.u.

HEAT EXCHANGERS

Hot vapors from separator . . . . . 29,020,700 B.t.u.
Preheated fresh feed
83.33 bbl/hr 40°F.
API 350°F. . . . . 3,692,500 B.t.u.
Vapors leaving
610°F. . . . . 25,377,200 B.t.u.
Heated fresh feed
580°F. . . . . 7,336,000 B.t.u.

In = 32,713,200 B.t.u. Out = 32,713,200 B.t.u.

FRACTIONATOR

Vapors from exchangers . . . . . 25,377,200 B.t.u.
Vapors leaving overhead 425°F. . . . . 4,757,900 B.t.u.
45.833 bbl/hr P. D. vapor 12.5 bbl/hr gas
Bottoms 166.66 bbl/hr 580°F. . . . . 15,701,000 B.t.u.
To be dissipated by
60 bbl/hr reflux . . . . . 4,918,300 B.t.u.

In = 25,377,200 B.t.u. Out = 25,377,200 B.t.u.

EXCHANGERS
(Partial Condensers)

Vapors from fractionator distillate, gas, reflux 425°F. . . . 9,676,200 B.t.u.
50 bbl/hr distillate, 290°F.
68.33 bbl/hr vapors 290°F. . . . . 5,983,700 B.t.u.
Pre-heated fresh feed 350°F. . . . . 3,692,500 B.t.u.

In = 9,676,200 B.t.u. Out = 9,676,200 B.t.u.

ACCUMULATOR

166.66 bbl/hr recirculating oil from fractionator, 580°F. 15,701,000 B.t.u.
83.33 bbl/hr heated fresh feed, 580°F. . . . 7,336,000 B.t.u.
250 bbl/hr stock to furnace . . . . . 23,037,000 B.t.u.

In = 23,037,000 B.t.u. Out = 23,037,000 B.t.u.

CONDENSING AND COOLING COILS

From partial condensers 50 bbl/hr distillate 290°F. 68.33 bbls/hr vapors 290°F. 5,983,700 B.t.u.
Tar from separator 700°F. . . . . 9,776,550 B.t.u.
12.5 bbl/hr gas, inclusive unaccounted for losses . . . . . 504,000 B.t.u.
To cooling water . . . . . 15,256,250 B.t.u.

In = 15,760,250 B.t.u. Out = 15,760,250 B.t.u.

OVERALL BALANCE

The over-all heat balance formula, as developed in the article "Heat Flow Diagram for Two Stage Distilling Plant" REFINER & NATURAL GASOLINE MANUFACTURER, February, 1933, holds also for a cracking plant.

$$F = S + D + G + W$$

"F" Fuel . . . . . 24,962,000 B.t.u.
"S" Stack losses . . . . . 6,240,500 B.t.u.
"D" Drum and radiation losses . . . . . 2,961,250 B.t.u.
"G" Gas and unaccounted for . . . . . 504,000 B.t.u.
"W" To cooling water . . . . . 15,256,250 B.t.u.

In = 24,962,000 B.t.u. Out = 24,962,000 B.t.u.

A condition that the diagram shows is that large quantities of heat are involved, compared with the small amount that finally goes into actual distillate vapors. The distillate carries off five million B.t.u., while the furnace supplies 25 million and the circulating oil embodies 50 million.

It also suggests that probably a larger amount is dissipated by radiation, due to high temperatures and large quantities of heat stored in circulating stock, than is usually suspected.

Hot tar carries off most of the supplied heat and it seems desirable to apply efficient heat-exchange at this point.

Application of Tube Stills *to* Petroleum Refining

C. M. JOHNSON
Consulting Petroleum Engineer, Houston, Texas

TUBE STILLS having demonstrated their usefulness for petroleum refining operations, the later developments in their design have been in the direction of improved thermal efficiency. The earlier designs operated with low furnace temperatures and large volumes of furnace gas because the fuel was burned with much excess air. It was quite possible to provide sufficient heating surface to lower the temperature of the flue gas to within 150°F. of the temperature of the inlet oil, or, when inlet-oil temperatures were high, to have the flue gas escape at 300° to 350°F. by using the heat remaining in the flue gas from the still to preheat the air supplied for combustion. But even so, the thermal efficiency was low because of the large quantities of air used for combustion.

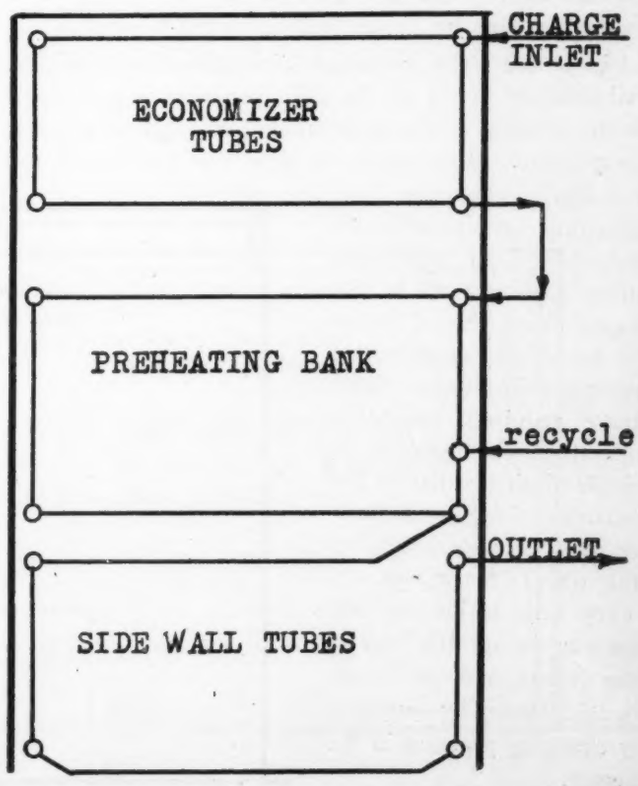
The large quantity of excess air was required to burn the fuel in the furnace at a temperature low enough to prevent overheating the furnace walls and overheating of the oil. Supplying the heat to the tubes of the heating surface at a rate beyond the capabilities of the oil to absorb, except with a considerable difference between the temperature of the inside of the tube and oil passing through, would result in overheating of the tubes and the oil in contact with them. For these reasons it was necessary, in the older types of tube stills, to burn the fuel with large quantities of excess air; resulting in low thermal efficiency despite the low flue gas temperature. Neglecting loss by radiation, the thermal efficiency could be improved only by burning the fuel with less excess air, but, it was necessary to accomplish this without upsetting the furnace temperature conditions existing when large quantities of excess air were used.

There are several methods of bringing this about, such as controlling the furnace temperature by returning a proportion of the flue gas to the furnace, or, by exposing direct to the fire a heat absorbing surface so located and proportioned that sufficient heat would be absorbed by radiation to prevent excess furnace temperatures.

Modern heaters are generally constructed having large furnace volumes to complete combustion of the fuels and prevent flame impingement either upon the radiant or convection banks of tubes. This is of utmost importance as flame impingement casuses local overheating with detrimental results both to the tubes affected as well as to the oil passing through. The surface directly exposed to the furnace (radiant tubes) should be located beyond the reach of any flame but directly in the path of the hot furnace gases passing to the flues.

All combustion being completed in the large furnace volume leaves only the transparent gases of combustion to come into contact with the heating surface. By carefully proportioning the radiant and convection surface enough heat is absorbed from the gases of combustion by the radiant surface that the temperature of these transparent gases of combustion has been lowered to a point where intimate contact with the convection surface absorbs the remaining available heat.

The convection surface, being located behind a bridge wall, is protected from direct radiant heat and

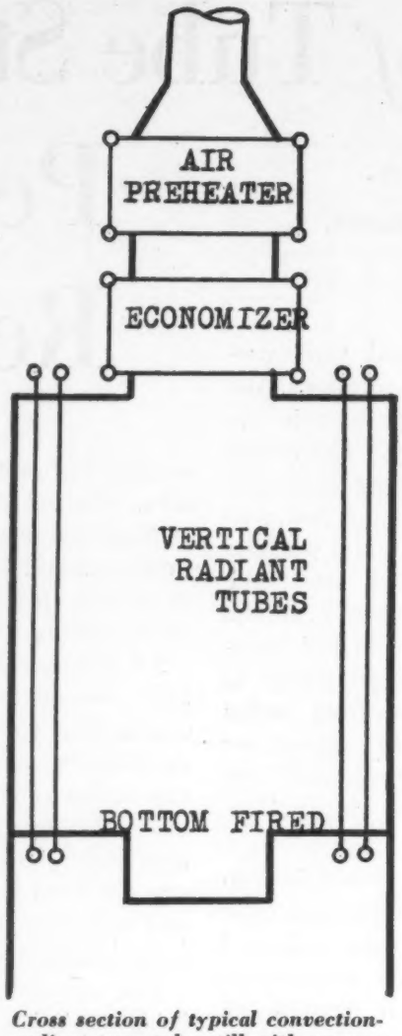


Cross section of typical convection-radiant type tube still.

flame impingement by this bridge wall, and, being located in the flue behind the bridge wall is in a relatively restricted space, thus forcing the gases of combustion to pass over this surface at a high velocity which results in a relatively high rate of heat transfer.

It seems unnecessary to dwell upon the advantages of the modern pipe still as compared with the older types of refinery distillation equipment. The relatively low cost, coupled with remarkable operating efficiency, precludes the consideration of other types except in rare cases where some peculiarities of products may have some influence.

The question of the actual heat required to distill petroleum is quite involved. We have extensive data on the latent heats of the various hydrocarbons under different conditions of pressure. We also have information regarding these specific heats of various oils and the effect of temperature thereon. Because of the complexity of petroleum and of each fraction, it seems almost impossible to theoretically analyze the partial-pressure effect of the great number of hydrocarbons upon one another during distillation.



Cross section of typical convection-radiant type tube still with convection soaking bank.

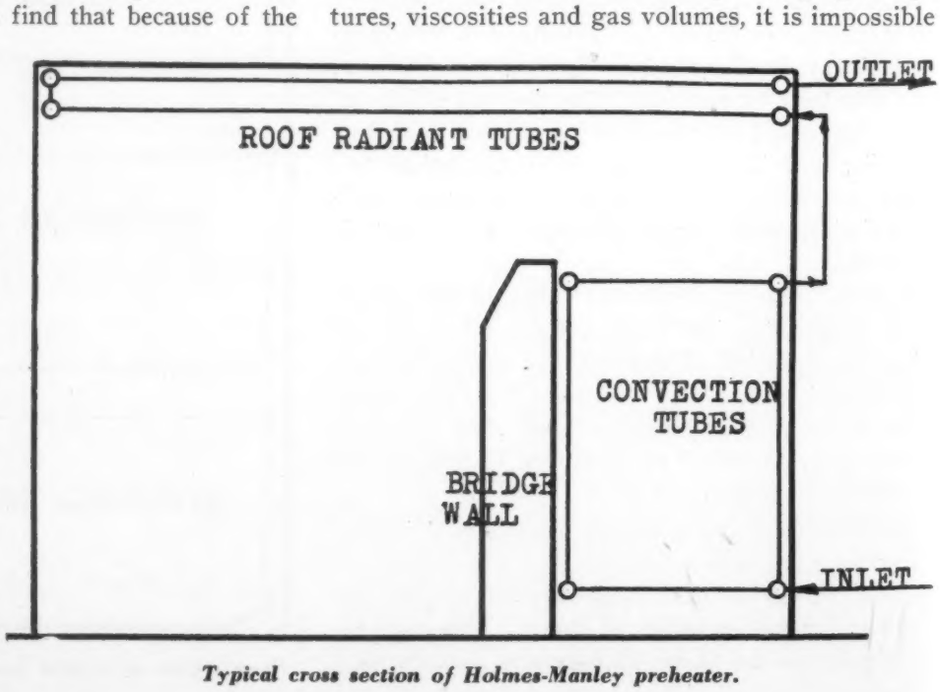
Theoretically, if an oil were heated in a tube still for a single flash operation, the partial-pressure effect of the light products would result in the removal of the same amount of vapor as a lower temperature. Practically, we find that because of the necessarily extensive fractionating equipment required when separating many products all in the vapor phase, the oil has to be heated to temperatures corresponding to, or above those required for batch operation. Furthermore, in single flash distillation the vapors evolved in the heater must be superheated to the outlet temperature. Very little is known concerning the specific heat of the vapors, and the theory is complicated by constantly changing pressure in the heater.

The efficiency of heat transfer is dependent on the velocities of the two exchanging mediums and oil is a relatively poor conductor of heat. For efficient transfer of heat we must have counterflow of the exchanging mediums which is easily accomplished in the design of a pipe still.

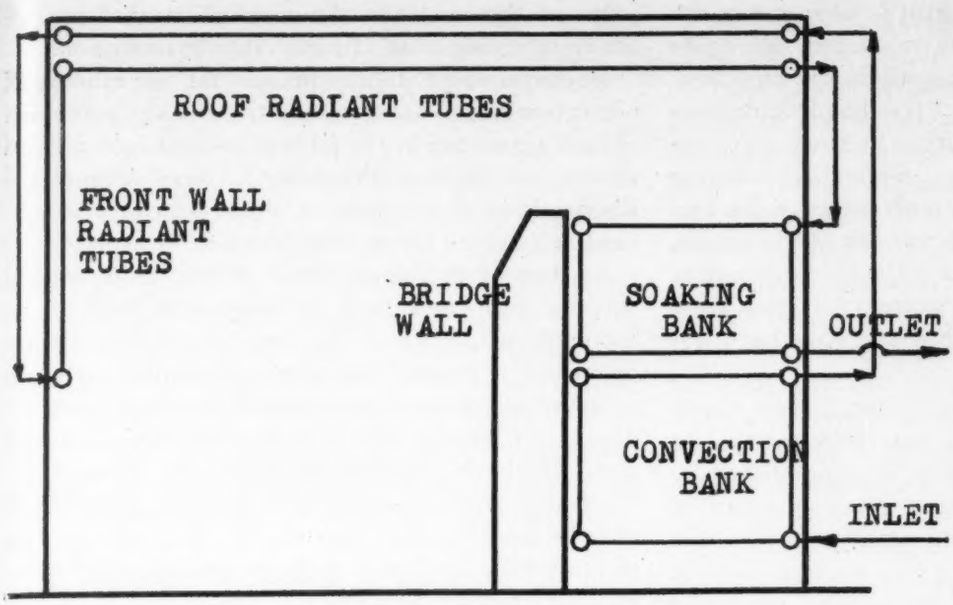
We are familiar with the two phenomena of fluid flow in pipes. First, "stream line" flow, where the fluid may be considered as a number of concentric cylinders each sliding past its neighbors; that next to the wall of the conduit as the slowest motion, the center one as the fastest. As increments of pressure are applied the velocities are increased until a point is reached where further increments of pressure produce no increase of velocity. With further increases of pressure, a second point is reached where a further increment again increases velocity. The fluid has now reached the second phenomenon of flow called "turbulent."

Obviously, under the first conditions the outer cylinders of the fluid passing through a heater are raised in temperature above the average of the fluid, and local overheating is probable. When the flow is turbulent, the fluid is rolling around and eddying through the tubes and conveys heat from the wall of the tube to the body of oil so that local overheating is avoided.

On account of the constantly changing temperatures, viscosities and gas volumes, it is impossible to



Typical cross section of Holmes-Manley preheater.



Typical cross section of De Florez radiant tube still.

theoretically predetermine the pressure drop through a pipe heater. The best forecast is empirical, based upon tests of similar heaters in service.

With reference to the furnace proper, it was stated that the pipe still is admirably adapted to counter-flow of oil and flue gases: therefore it is generally possible to bring the exit gas temperature down to as low a figure as will provide sufficient draft. With the usual heat exchanging systems, inlet oil temperatures of 300°-350°F. are encountered. Occasionally, more extensive application of heat exchange is made and temperatures to 500°F. are obtained. It should be pointed out that inlet oil temperatures around this figure begin to affect the furnace efficiency adversely.

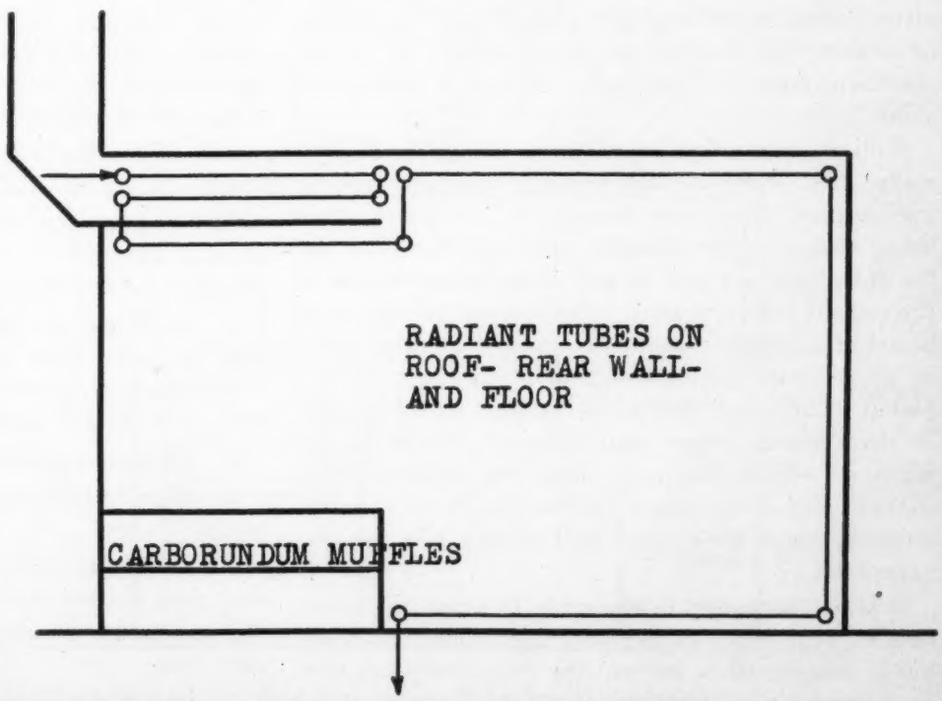
Correct furnace design is of prime importance to successful pipe still operation. Radiant surface will absorb heat at a much higher rate than convection surface; therefore the part of the pipe still doing the most work per square foot of surface is that exposed to direct radiation. The design of this section must carefully analyze the oil temperatures and velocities to be sure that it will be able to absorb this heat. Otherwise, carbonization and burned tubes are inevitable.

It has been found that radiant heat and flame impingement on the same surface create a serious condition. By elimination of flame impingement, higher furnace temperatures may be carried. The radiant tunnel construction is a development along this line.

Another line of approach towards the elimination of overheating is to keep furnace temperatures at a lower degree. The admission of excess air to accomplish this purpose is wasteful from all standpoints but is the method generally used in most plants. Recirculation of the flue gases will attain the results desired and at the same time maintain high efficiency. The recirculation furnace is primarily a heating apparatus of the convection type in which the heat absorbing surfaces are heated by a mixture of fresh products of combustion and a portion of the combustion gases already given off a part of their heat in their previous passage over the heat absorbing surfaces.

In its basic conception, the recirculation furnace can be considered as a closed thermal system in which the heat-absorbing surfaces are constantly swept by a fixed quantity of products of combustion at a given initial temperature with the gases being constantly returned to the furnace and reheated before they again enter the heating zone.

The recirculating furnace is the most suitable apparatus for heating by convection where low furnace tempertaures must be maintained and where only a



Cross section of Alcorn typical all radiant type heater, featuring the carborudum tunnels

small portion of the available heat is taken out of the gases, particularly where the maximum allowable furnace temperature is low and where the final temperature of the gases is only a few hundred degrees below their initial temperature. In such cases recirculation not only provides a method of reducing the rather high combustion temperatures of the fuel when burned without a large amount of excess air, but, by returning to the furnace the heat content of the gases at their final temperature, recovers a large portion of heat that otherwise would have been lost through the stack.

The convection type oil still is particularly suitable for the application of flue gas recirculation. In an oil still, the heating of the oil is accomplished by applying to the tube surfaces a given quantity of heat of a certain predetermined quality, usually with the initial temperature of the gases not over 1500°F. To obtain the full benefit of the heating surface of the coil, the final temperature of the gases after passing over the coil is kept within 300°F. higher than the temperature of the incoming oil.

While not a cure-all for the ills of refinery heating, the recirculating furnace, properly designed and equipped will produce a milder heat application, give larger throughput with the same amount of heating surface and perform the heating with less fuel and better efficiency than the non-recirculating convection furnaces, and in many cases the radiant heat furnace as well.

While the term radiant heat is broadly used to cover all heat energy transferred from one body to another by radiation, in contradistinction to heat given up by gases in direct contact with the heat absorbing surface (convection) or transmitted simply by conduction, in furnace work it is perhaps more often limited to the heat given off either by the gases or refractories used in furnace construction, which are themselves at sufficiently high temperature to show "color."

Radiant heat may be supplied in either of two ways—the "open" radiant heat in which the absorbing surface "sees" the flames and in some cases being swept by the products of combustion and the "shielded" radiant heat in which the actual source of the radiant heat is a small incandescent furnace composed of a highly conductive super-refractory, within whose walls the combustion of the fuel is completed. This small furnace is usually located directly in the furnace proper and although its refractory walls do shield the heat absorbing surfaces from contact with the gases of combustion, there is no interference with the radiant heat given off by the furnace itself.

It is not necessary or desirable to shield or screen radiant heat when properly applied and controlled, but it is essential to prevent the excessively hot gases of combustion from coming in contact with those parts of the heat absorbing structure that are already receiving heat at high rates by radiation.

In connection with any process for the refining of oils it is most advantageous to transfer the maximum of heat generated in the form of radiant heat applied directly to the heat absorbing surfaces without the interposition of any form of shield or screen to prevent or reduce radiant heat transfer.

As long as the management of the refineries was satisfied with their daily capacity or throughput, an economy in fuel was not an essential factor in plant operation, it mattered little whether the heat necessary for any process was applied by convection, radiation, or conduction; or a combination of any of these methods. When, however, the demand for finished products made it necessary and profitable to greatly increase throughputs, the tube still largely displaced the shell still both for straight distillation and for cracking processes.

Economy in operation also became a factor at the same time and every effort possible was made to reduce the amount of fuel consumed per barrel of charge.

The most obvious method of reducing fuel consumption was to reduce the amount of excess air. While this resulted in saving fuel, the increase in tube trouble and resulting loss in time on stream more than offset the saving of fuel. This was particularly true in the operation of such tube stills and cracking coils as required high temperatures and which had a greater tendency to coke up the tubes. The heavier the charging stock, the more pronounced the difficulties and as the refractories increased in radiance, the direct result of increased combustion temperatures, tube failure became more pronounced. Recirculation helped this condition and permitted better economy, at the same time increasing the transfer rate because of increased gas velocities. It necessitates, however, expensive blowers and ducts, increased first cost, and at the same time was a source of constant expense both for power and maintenance.

The importance of furnace efficiency has now become generally recognized and the following conditions are regarded as almost fundamental:

1. Sufficient air for complete combustion of the fuel but with little or no excess air. A preheated combustion air further improves operating conditions and reduces stack losses.

2. Thorough mixing of the fuel and the air.

3. High furnace temperature until the fuel is completely burned.

4. Sufficient furnace volume to insure the necessary time for the combustion to be completed before the gasses come in contact with the heat absorbing structure.

5. Proper arrangement of the heat absorbing sur-

faces to insure uniform and efficient heat transfer.

The application or use of the various types of heaters in the petroleum refining industry, particularly as applied to cracking units, requires a very careful consideration of the character of the charging stocks. There is also the factor of time-temperature conditions to be considered. Certain engineers or processes prefer moderate temperatures and long soaking time, while another school is an exponent of the high temperature—short time reaction.

The Holmes Manley process is characterized by the long time of reaction provided in a multiple chamber arrangement and uses De Florez radiant type heaters or Holmes Manley radiant-convection preheaters. This process is designed to operate on clean charging stocks and is of the internally recycling type.

The Dubbs process is built for either clean or dirty charging stock and employs heaters of all classes.

The Cross process is designed for clean cracking stocks and employs a convection-radiant type of heater with a reaction chamber in the transfer line between the still and the flash tower.

The Winkler-Koch process operates upon clean cracking stocks but does not use a reaction chamber. The cracking stock is brought to cracking temperature through convection-radiant tubes then allowed to soak for a predetermined time in convection tubes and then flashed at lower pressure into the flash drum.

Obsolescence being the worst enemy of the refining industry it behooves the management to install equipment or processes which will give the maximum results for the minimum investment.

While proper furnace design and operation does not by any means insure the success of any process, since many other factors are present, there is no question but that such operation materially simplifies the operator's problem. Poor furnace design and conditions undoubtedly are responsible for many plant difficulties, while good furnace conditions, with properly designed tubed arrangement and oil flow, permit of greater latitude in controlling the process and may be a considerable factor in better yields, greater throughput and superior quality.

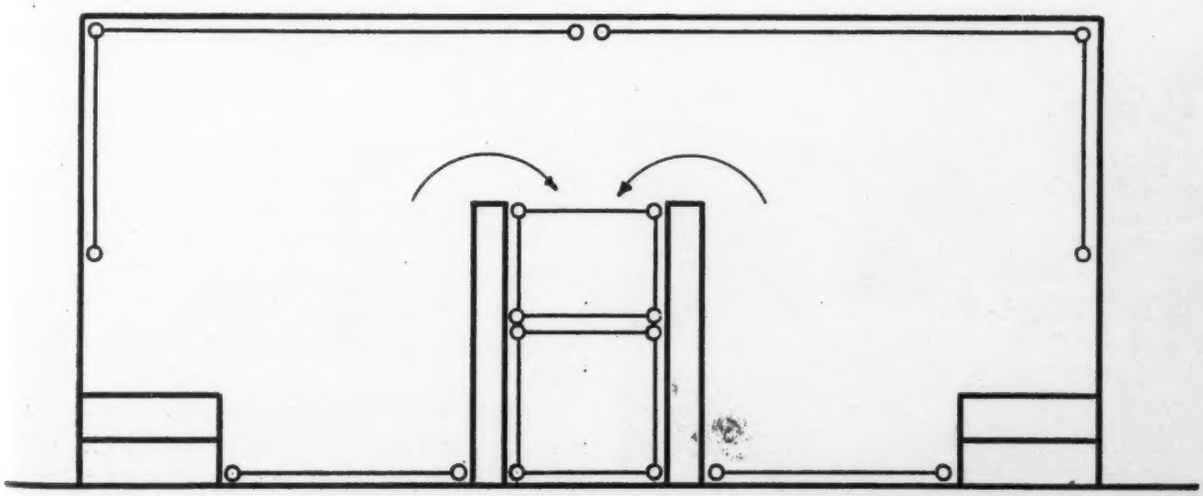
Refiners realize that higher octane values usually may be secured by higher transfer temperatures. To permit such temperatures absolutely even heating is essential.

Before building a furnace for any particular process today a refiner should look carefully, not only at the process requirements at the time, but also to the probable trend of public demand and the consequent changes in operation which may be necessary to meet this demand.

The furnace design should be such that perfect combustion of the fuel is assured with no possibility of secondary combustion. All of the tubes should do their share of the work with no idle tubes. This means a high general average with no tubes operating under dangerous conditions and is only possible with even heat conditions.

If required the furnace should be capable of handling high transfer rates safely, to accomplish which it is essential that the tubes carrying the hottest oil should not be subjected to contact with high temperature gasses and the consequent danger of local over-heating. Excessive size should be avoided since this means greater first cost, more maintenance expenses, and requires greater valuable ground space. Too many tubes also mean an excessive pressure drop through the coil requiring more expensive pumping equipment and more power for pump operation.

The furnace best adapted to modern refinery practice should be simple and compact, flexible and safe, easy of operation and control and should be designed to meet tomorrow's requirements where possible.



Cross section of Alcorn typical high efficiency duplex operation tube still, featuring carborundum muffles, with floor and roof tubes

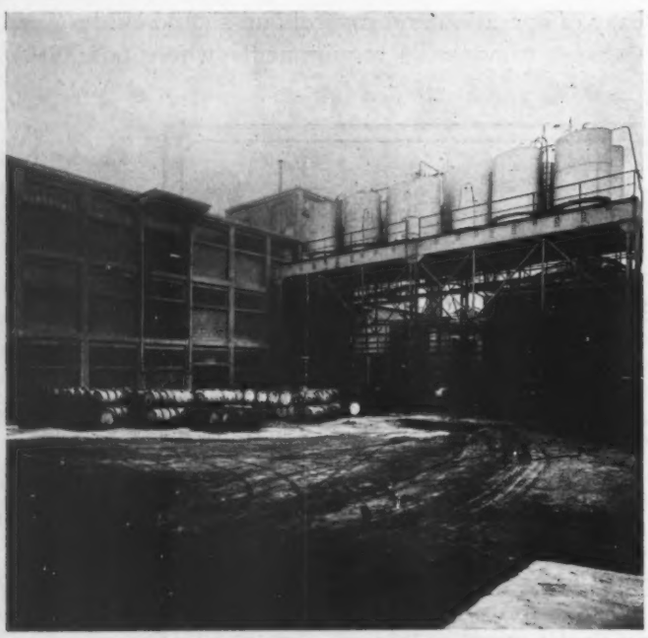
Continuous Acid Treatment *Effective In Belgian* Lubricating Oil Plant

IN the accompanying contribution sent to The Refiner by M. Grisard, Manager, Belgian Lubricating Products Company, the writer discusses the advantages and results secured when using the new continuous De Laval S-N process for acid treatment of lubricating oils. Mr. Grisard has particularly studied the production of special greases for rolling mills and other industrial machinery and for the past 15 years has specialized on the refining of lubricating oils for internal combustion engines, especially gas engines. The products of his company are widely marketed in Belgium, Luxemburg, and the main French industrial districts. Results secured with the new process are considered by the Directors of the Belgian Lubricating Products Company as highly satisfactory and the company plans to increase its production through additional installations to engage in production of light transformer and turbine oils.

BELGIAN Lubricating Products Company with works in Cuesmes-lez Mons, Belgium and Marly-lez-Valenciennes, France, has for many years been engaged in production of lubricants, special greases, and oils for internal combustion engines. Greases for rolling mills, and lubricating oils for gas engines, and the like, find wide distribution throughout the industrial districts of Belgium, Luxemburg and France.

Automobile oils marketed by this firm consist of three grades or qualities, such as orange with a light green reflux, red with a green reflex and straw yellow. Due to the high quality and unusually light color of such automobile oils the costs of refining were rather high and in order to reduce these costs Mr. Grisard, manager of the company, investigated various processes with the view to effecting lower processing expense. In 1932 the new continuous De Laval S-N. acid refining process was studied and installed; by this process the company succeeded in producing in regular operation lubricating oils which were highly satisfactory, not only in regard to quality but also in regard to costs of production.

The refining process is carried out in the following manner: The oil is intimately mixed with acid in a mechanical mixing apparatus, and the mixture is then left for the time required to finish the reaction. In order to avoid the sludge formed during the reaction becoming re-dissolved in the oil, thus impairing the color of the finished products, the acid treated oil is then immediately conducted into a De Laval S-N. acid sludge separator (centrifuge) where the acid sludge is completely removed.

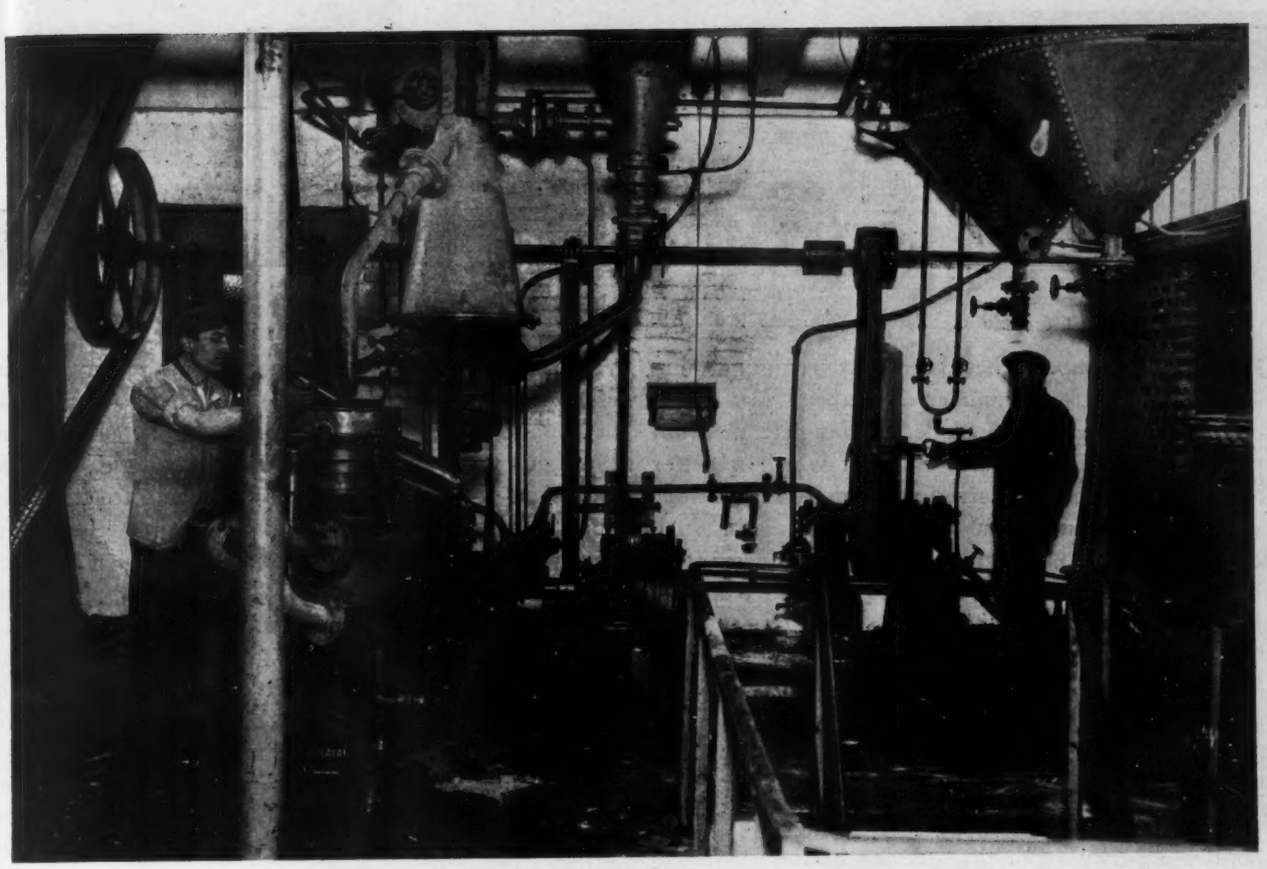


A corner of the yard

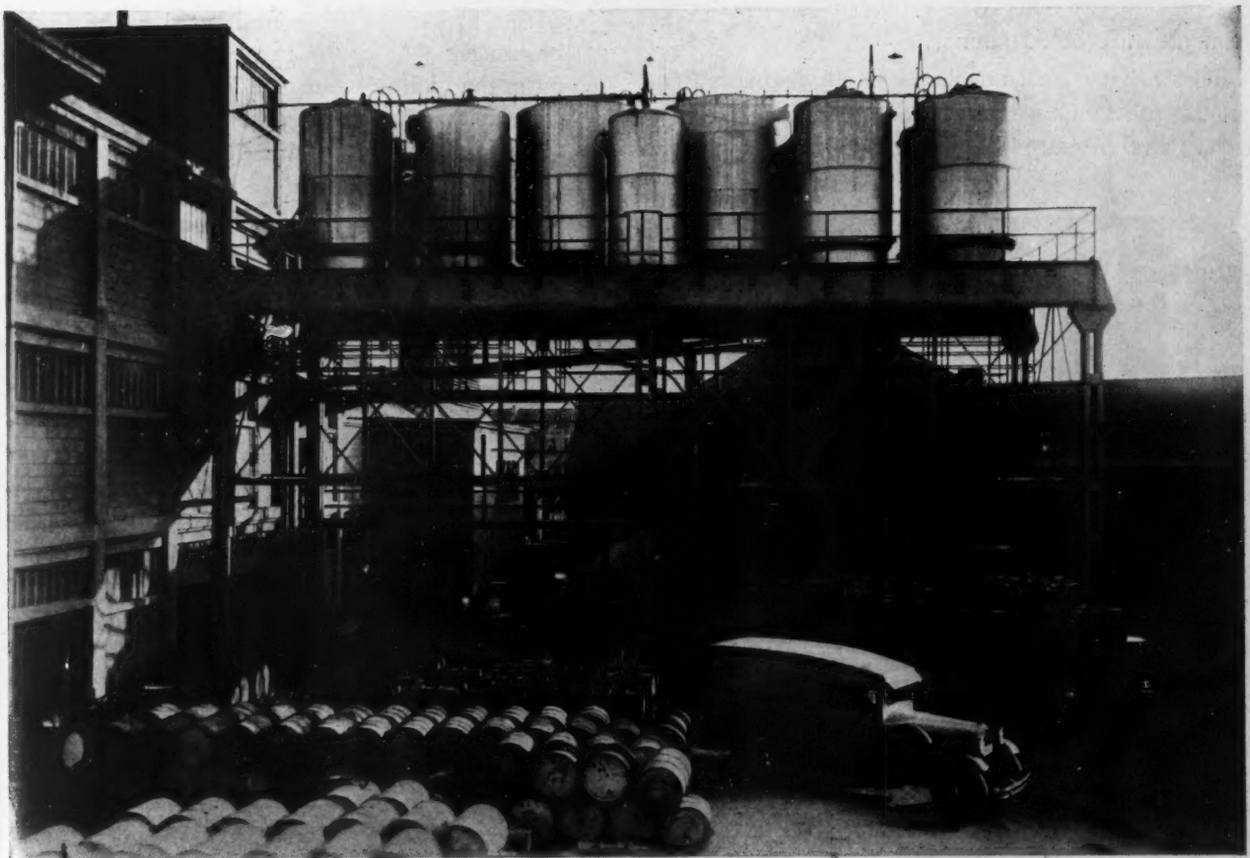
The oil is then neutralized and bleached with activated earth in ordinary agitators according to the method commonly practiced. When leaving the filter in which the bleaching earth is removed, the oil is taken to a second De Laval separator in which any remaining traces of filtering earth and moisture are eliminated.

Due to the efficient mixing of the oil and acid and to the intentionally sharp limitation of the time of reaction, (by means of the acid sludge separator) it has been possible to reduce the quantity of acid required for obtaining the desired color to one third of the amount formerly used in the ordinary batch method of acid treatment in air agitators. In addition the refining loss is much smaller and the stability of the oil is superior to that obtained in discontinuous chemical refining in agitators.

In each of the two De Laval separators 10 to 20 tons of oil having a viscosity of 18° Engler at 50° C. can be treated in eight hours. The capacity is, of course, somewhat higher when treating the less viscous oils.



View of De Laval S-N. Separator system as installed in the refinery of the Belgian Lubricating Products Company, Mons, Belgium.



Exterior view of the Belgian Lubricating Products Company refinery at Mons, Belgium.

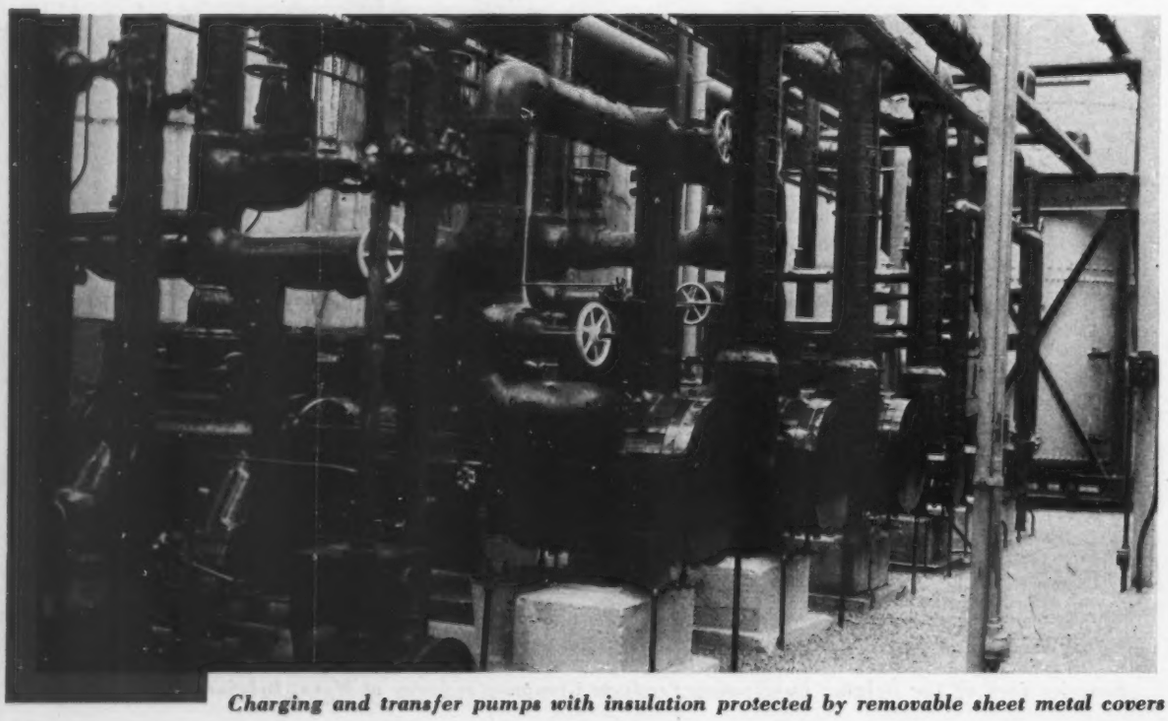
Pure Vapor Recovery Plant *At Muskogee* Is Efficient

PURE Oil Company has been recovering gasoline from vapors for a number of years at Muskogee, Oklahoma, but in 1932, installed a complete new absorption and distillation unit through which a better recovery of gasoline is obtained and a more satisfactory product manufactured for blending with motor fuel. Alco Products, Inc., designed and erected this unit to handle 5,500,000 cubic feet of vapors coming from the various processes of the refinery.

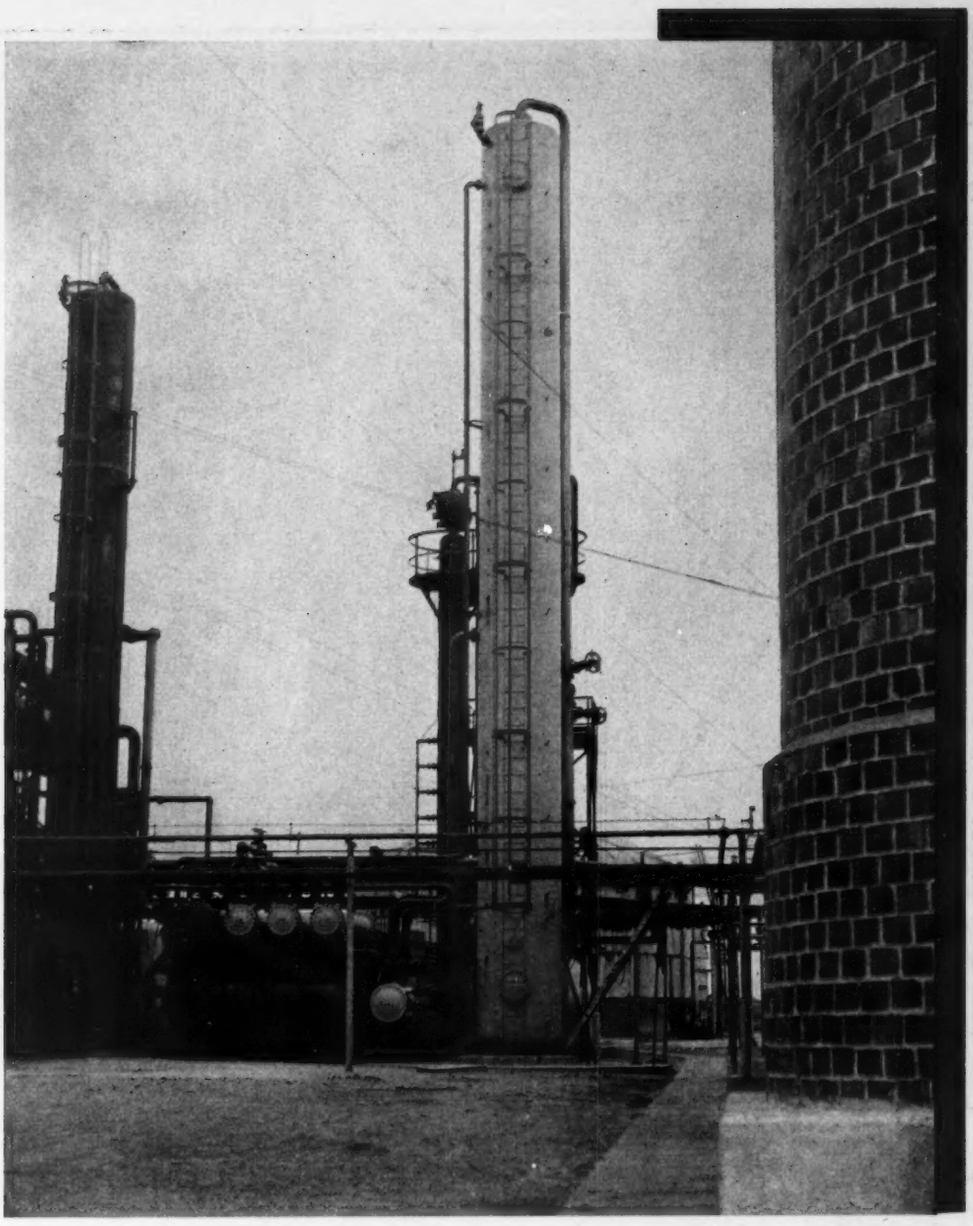
Three twin 200-horsepower Bessemer gas engine-driven compressors handle all the vapors from the distillation except that coming off with the pressure distillate through the Cross cracking units. One of these cylinders handles the look box and run tank vapors, taking normally around 750,000 cubic feet. These vapors rise partly from the streams in the skimming tube still unit, and the others from the gasoline storage tanks. The other five cylinders compress the vapors coming from the Gyro vapor phase units, while the Cross process gas enters the recovery plant under the system pressure of 35 pounds.

Vapors originating from the pipe still distillation and from the run tanks contain on an average of 10 gpm; Gyro vapors produce 5 gpm and the Cross cracked vapors average 7½ gpm. All gas from the engine room and that coming from the Cross units enter the absorber at a common point, with the absorption medium flowing through the tower in the conventional manner, with the exception that as the oil flows downward over the bubble trays, it is trapped off and brought outside to be circulated through an intermediate cooler and then re-enters the absorber to complete the flow downward to contact the gas in the base of the tower. Absorption oil enters the column at 73° F. and is removed from the base at 107° F. The gas, a composite feed from the various units, enters the absorber at 76° F. and leaves as plant fuel from the top of the column at 118° F.

Two stills are used, both high and low pressure, and as the oil is taken from the base of the absorber, it is pumped through sufficient exchanger capacity to bring the temperature from 107° F. to 340° F. Passing into this column under a pressure of 65 pounds, a part of the volatile product of absorption is removed, the oil leaving at a temperature of 320° F. Eight hundred pounds of live steam per hour is used in the first step of the process. After the gasoline vapors driven from the oil in the high pressure still are condensed, the temperature at the water and gasoline separator is 86° F. By refluxing a portion of the gasoline from the water



Charging and transfer pumps with insulation protected by removable sheet metal covers



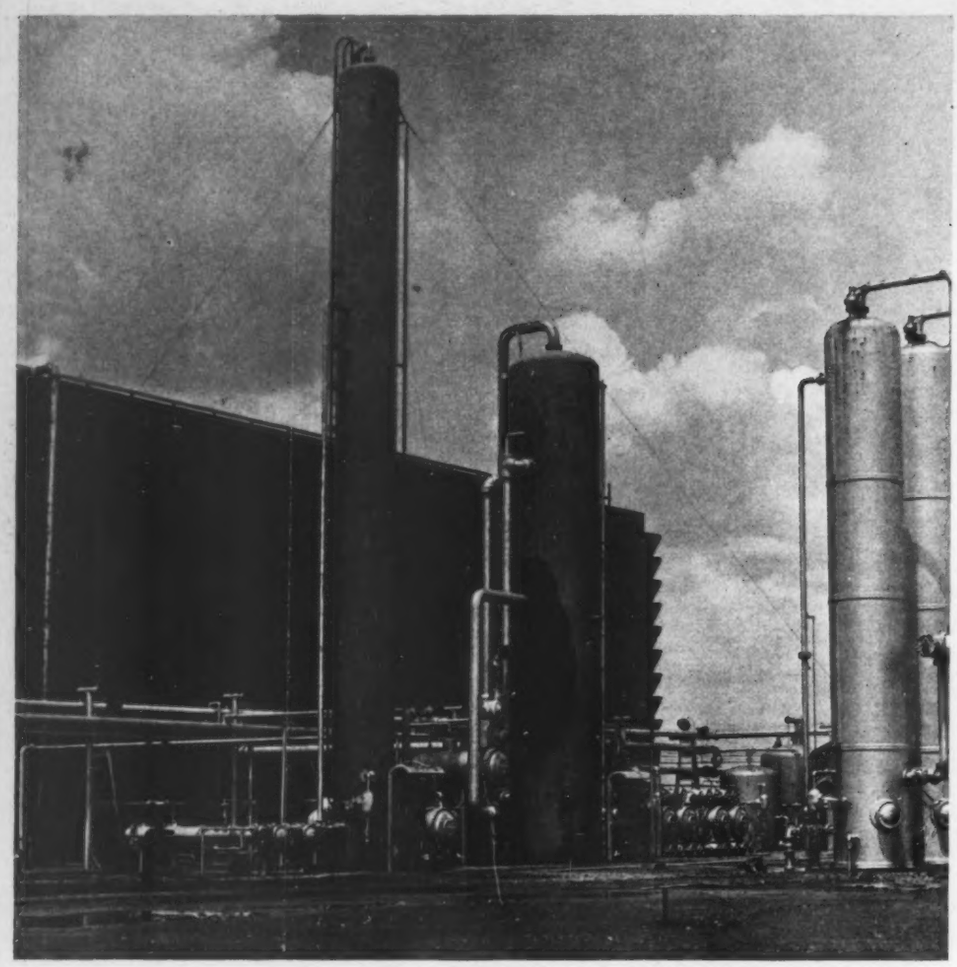
Vapor recovery system, Pure Oil Company, Muskogee, Oklahoma, refinery

and gasoline separator, the top of the high pressure still is maintained at 198° F.

From the high pressure still the oil passes directly to the low pressure unit. The partially stripped fat oil enters at 320° F. and is processed under a pressure of seven pounds. In this unit 1550 pounds of exhaust steam under a back pressure of 35 pounds is used for processing the fat oil. The oil leaving the low pressure still has dropped to 308° F., and is stripped to 404° F. as an initial boiling point. The gravity of the lean oil averages 37.5° A.P.I. Gasoline condensed averages 74° F. in the gasoline and water separator, and by refluxing the low pressure still overhead stream is maintained at 194° F.

The product manufactured through the high and low pressure stills is fractionated in one of the towers which was used in the former recovery plant. This column has 30 plates and is operated at 170 pounds pressure. The bottom temperature averages 250° F. with the top provided with water-cooled condensers controlled for refluxing. Finished gasoline is propane free and averages 80° A.P.I. The boiling range of the finished product runs from 80° F. I.B.P. to 306° F. as a final boiling point. The color is 30 plus and after finishing with doctor, the recovery averages 96 per cent.

One feature stands out above the others in this plant and that is the cleanliness of the equipment and grounds. Circulating and gasoline pumps set to operate in the open, steam reciprocating, are enclosed as needed in jackets of insulation which is protected by sheet metal covers. The steam ends of the pumps are covered with the metal protectors fabricated in the plant shop. They have been designed to be removed at any time without marring the contours and when applied, the units are painted with the formation block with contrasting colors. The pumps are further protected with bleeder cocks extended to drain lines which lead to the plant sewer.



Big Lake Oil Company's absorption plant at Texon, Texas, handling sweet gas from 8500-foot sand on the same site as the company's compression plant which processes sour gas from the shallower producing zone.

Big Lake Gasoline Plant

Operates Under Well Pressure

PREVIOUS to the discovery of oil in the 8500-foot producing zone gas was treated for the recovery of desirable fractions in a compressor operated plant by Big Lake Oil Company at Texon. As the volume of comparatively sweet gas was increased when a number of wells reached the Ordovician production, a well pressure plant was erected to process this gas under 250 pounds pressure.

The complete unit was furnished by C. F. Braun Manufacturing Company and consists of three high pressure absorbers, each having a capacity of 30,000,000 cubic feet of gas. Oil is circulated to these absorbers at the rate of seven gallons to the thousand cubic feet of gas entering them through a Worthington 10 x 9 x 18-inch pump discharging against 275 pounds pressure.

The gas is brought into the plant through a separate gathering system with the gasoline content averaging .30 gallons per thousand. As it is produced from the wells under controlled production, the gas is always low in temperature. Due to this feature, it is fed directly to the absorbers without auxiliary cooling.

Water and oil are circulated by high gas pressure. DeLaval turbine driven booster oil pumps and water circulating units, the high pressure oil pump and the stabilizer feed and reflux pumps are all driven by gas pressure. The requirements for sweet gas in the field are large, but required under low pressures, 35 to 40 pounds for field distribution. To utilize the high process pressure and to assist in reducing the gas pressure before entry into the field residue gas fuel lines, part of it is passed through the process pumps.

To provide for clean gas free of moisture or other

condensate, that part used for driving the turbines and reciprocating pumps is passed through an extra scrubber. After it leaves the scrubber, the gas is passed through a heater to prevent refrigeration in the apparatus when reduced in pressure. A Braun exchanger is set on the line between the scrubber and the pumps, and the gas under 250 pounds pressure is introduced in the shell around the tubes. Steam under 250 pounds pressure is fed to the tubes of the exchanger to bring the temperature of the gas high enough for efficient operating purposes.

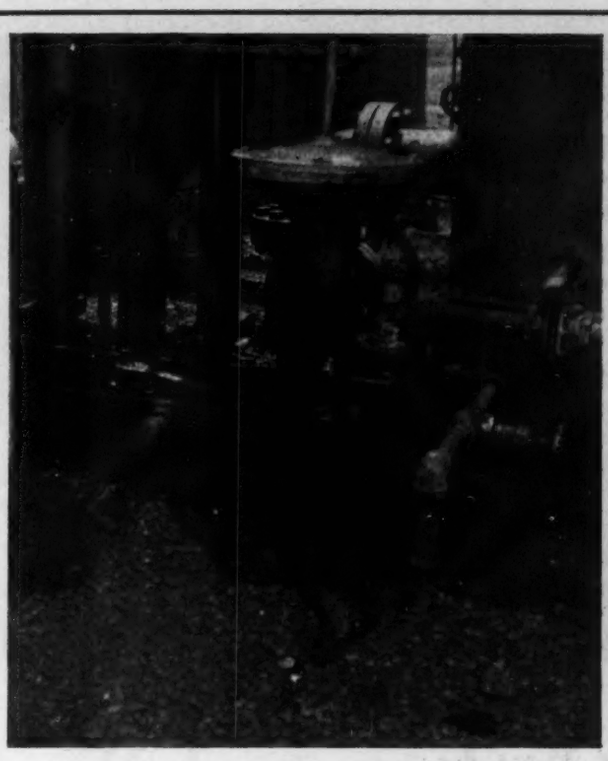
No steam is permitted to pass beyond the trap under the exchanger, and the condensate handled by the trap is fed directly to the boiler feed tank. Lubrication of the pumps is accomplished by feeding steam cylinder oil to the journals of the turbines, while gas engine oil is applied to the cylinders of the reciprocating pumps.

Finished stabilized gasoline from both the compressor operated plant handling high hydrogen sulfide gas and the sweet product from the pressure operated plant are blended together and treated in a continuous hypochlorite unit before being passed to storage.

As the sulfur content of the finished product must, under sales provisions, be below .04 per cent, two charges of hypochlorite solution are maintained in the treating plant at the same time. As the gas is treated in the first charge, and a sample taken regularly, it is replenished as soon as the gas is found off specification.

Large drums of chlorine are placed on a rack convenient to the chlorinating drums. Provisions are made for instant removal of the drum in service should a fire occur. Instructions are posted and a truck is always available for transportation of the unused portion of the chlorine to a safe distance.

After constructing the new gasoline recovery unit through which the gas from the deep wells is processed it was found that the excess propane and butane condensed from the final fractionator had a tendency to freeze the outlet control valve. To prevent accumulation of particles of ice on the valve and seat, a box was made from light tank steel and placed around the valve. Steam lines were run to this box and water poured in was kept at a boiling temperature. Evaporation was rapid and it was necessary for the stillman to replenish the supply at frequent intervals. If the water became too low to surround the steam coil and valve body, a tendency to freeze was experienced. To prevent this condition occurring, water was replaced with absorption oil. No evaporation at the box temperature is possible, and once filled, it is not necessary to replenish the supply in the box except at rare intervals.



Steam heated absorption oil prevents freezing of outlet control valve

Turbine driven oil pumps, water circulating pumps, the high pressure oil pump and stabilizer feed and reflux pumps are all driven by gas pressure

Mixing and control devices for carbureting propane-butane gases

Carbureted Waste Gases *Increase Fuel Supply* At Gasoline Plant

IN Burkburnett, due to the gradual decline of casing head gas, and to the fact that the gas taken from the casing heads is practically all gasoline vapors, the problem of maintaining a sufficient amount of residue fuel for engine rooms and field pumping units has become acute. Purchases of auxiliary gas from pipe lines have been made for many years, but when natural gasoline was required, which was fractionated free from propane and butane, that portion of the gasoline vapors was considered a waste product and burned either under the boilers or in a flambeau some distance from the plant, this overhead product furnished a possibility of augmenting the residue gas supply.

Skelly Oil Company, after making experiments leading to use of this "waste" product, found that by mixing the propane and butane with air in a carbureting device, the amount of gas purchases could be materially lowered. Of course when gasoline made at Burkburnett conformed to the grade of 26/70, there was very little of the lighter products to carburete. But as the vapor pressure of the finished product was lowered to 15 pounds, 11 pounds and in some instances nine pounds, the fractionated product removed from the "make" progressively increased.

The plants operated by Skelly Oil Company in Burkburnett are of the compression type, being installed in the boom days of that field when compression was the usual method of extracting natural gasoline. Production is obtained under two stages of compression, vacuum units bringing the gas from the field to the engine room.

As the gasoline is manufactured and accumulated in the high and low pressure drums, it is blended in a common container and pumped under 150 pounds to the conventional fractionating column. This column is a tray and cap tower with the usual equipment surrounding it, such as reboiler, heat exchanger, charging and reflux pump assembly. Temperatures required for the fractionation of the raw product into the desired bottom product are maintained on the reboiler and column, with the overhead vapors being reduced from 150 pounds to 90 pounds to enter the condensing equipment. Exceptionally hard water prevents use of shell and tube condensers, so atmospheric types were installed.

As the overhead fractions removed from plant production is condensed, it is accumulated in a large surge drum, six feet by 20 feet set in a horizontal position and insulated. Feed for the wet trim of the fractionating column is taken from the bottom of this tank and circulated over the top of the tower to control both the bottom and overhead product.

To utilize this excess product in enriching field resi-

due gas, propane and butane in varying proportions as requirements of the finished product dictates, is led through a shell and tube exchanger for the dual purpose of condensing the exhaust steam from the various pumps in the plant yard, and to partially heat the liquid before it is sent through the carbureting device. Enough exchange of temperature is effected in the shell and tube unit to condense the steam to boiler make up water, but not sufficient to bring the temperature of the liquid propane and butane to process requirements.

The product in process of carburetion is led to the main heater, devised by welding a jacket of pipe around the eight-inch exhaust of one of the 80-horsepower Bessemer gas engine-driven compressors. The threads were removed from this joint of 10-inch pipe and it was slipped over the exhaust which is placed above ground. Each end of the jacket was welded to the exhaust and spaced so that the annular space between the 10- and eight-inch was uniform. Three connections are welded to this jacket, two near the middle and one at the engine end. Those at the center of the jacket are used as intake connections for the system and to provide for a relief setting to protect the system should excess pressures develop. The collar welded at the engine end of the jacket is outlet for the hot vapors in process of carburetion.

One of the compressors supplies air, discharging through a set of atmospheric coolers to condense the water vapor contained in the air before permitting it to enter the carbureting device. This device is set low down on the ground, the apparatus for intimate contact between the compressed air and hot vapors being below the surface. Both the supply of gas from the heater and the air from the compressor is maintained in predetermined proportions by two rate-of-flow control meters. These controllers are set with suitable orifice flanges and plates to give an accurate reading of the process volumes. Air is controlled through a one-inch control valve and the gas through a half-inch.

Pipe connections lead from the air and gas control valves to the intimate mixing device which is constructed of four-inch outside as a jacket and a perforated pipe inserted inside. Pressure of 30 pounds is maintained on the carbureting device with the cold dry air being mixed with the propane-butane under a temperature of about 250°F. Proportions of air and gas vary as to the climatic and field conditions. A one-two mix—one of gas and two of air—was being used in July to provide a fuel of sufficient Btu content for satisfactory engine performance.

After the gas and air have been thoroughly carbureted in the proportioning device, it is carried to a scrubber to remove any liquid condensate. If for any reason the air compressor should go down suddenly, it will also prevent the passing of heavy propane and butane in the liquid phase to the field lines carrying the residue fuel gas. The air content of the finished plant and field fuel gas is rigidly controlled, and when the mixture of plant residue, carbureted gas and purchased dry gas contains an unsually large percentage of air, the propane-butane and air carburetor is changed to remedy those conditions.

This apparatus has been in operation at Burkburnett for a considerable time and at no time has there been an unsatisfactory fuel gas developed. Making 11-pound gasoline, the device furnished approximately 275,000 cubic feet of fuel gas when operated as it was in July of this year.

Propane - Butane Heater installed around engine exhaust

USE OF Continuous Vacuum Filters *in* Contact Treating

L. C. TRESCOTT

THE continuous vacuum filter was originally devised to handle large quantities of the slimes from metallurgical processes easily and at the lowest possible cost. In places where this type of filter can be used it has shown decided advantages, but, due probably to a lack of knowledge of this particular equipment it has not come into wide use in the filtration problems of the contact treatment of mineral oils.

It must not be taken that this type of filter can be thrown into any contact treating process and used successfully and economically. As is usually the case with continuous processes, it was intended for use in cases where considerable quantities of the same sort of material were to be handled; where the operation is carried on 24 hours a day. In the small contact filter plant, where the filter operation is intermittent; where the quantities of oil and clay handled are relatively small; where several grades of oil are to be handled with the same filter equipment, then it is better to go to pressure filters and batch operation. However, when the process can be laid out for continuous operation, the installation of continuous vacuum filters merits consideration.

The big advantage of vacuum filtration lies in its continuous operation, its low labor cost, its high throughput of oil per square foot of filter area, and in the fact that the spent cake from such a filter, on account of its being a thin cake filtration, will carry very much less oil than the cake from a pressure type filter working under the same conditions, where the filter-cake must necessarily run much thicker.

It must be noted here that this type of filter is unsuited to the filtration of bright stocks or any oils in naphtha solution. It can be used on heavy stocks of as high a Saybolt viscosity as 120 to 130 at 210°F., where these are filtered straight without dilution. Pennsylvania stocks give much better flow rates than other grades, but it is usually more efficient and economical to filter these heavier grades in naphtha solution, particularly when they are to be dewaxed or centrifuged. All grades of oil up to a Saybolt viscosity of 100 at 210°F. can be handled by this type of filter with excellent results.

For the benefit of those unfamiliar with continuous vacuum filters, a flowsheet showing its operation is given in Figure 1.

It consists primarily of a drum, A, which runs partly submerged in the slurry to be filtered, which is held in the tank B. The face of this drum is covered with filter-cloth and it is divided into horizontal sections, a, b, c,—etc., each of which is connected by piping to a port in the rotary valve located at one end of the filter drum and revolves with it. This valve is connected with the receiver E by the lines 1 and 2, and the vacuum is applied from the vacuum pump G through the line 3 and 4. F is a catch tank which is periodically drained back into the receiver through the line 5.

In operation the tank B is maintained at the constant level X—X′. As a section of the drum revolves from X to X′ the cake is picked up on the face of the drum by the vacuum through the filter cloth and the filtration takes place. The vacuum through the pick-up section is controlled through the line 2. As the section revolves farther and leaves the mix in the tank, the drying begins. The vacuum on this part of the cycle is controlled through the line 1. In general practice the same vacuum is carried on both sections, although there may be times when it will be found advisable to vary them.

The drum revolves until the section is at a point one or two sections above the scraper which removes the cake. Here the vacuum is cut off by the rotary valve and enough compressed air is admitted under the cloth, to barely lift the cake from the cloth, and as it reaches the scraper the cake is removed at C. This scraper feeds to a conveyor which takes the spent cake on its way to the dump.

The filtered oil is drawn through the lines 1 and 2 to the receiver E. It is pumped from under the vacuum of the receiver by the pump H. which feeds to the blotter press I. A cooler is placed ahead of the press where necessary, to reduce the oil temperature to 180°F. and a cooler is placed after the press to reduce the temperature of the oil before it reaches the running tanks. This is to prevent loss of color.

The blotter press is of the plate and frame type using quarter-inch plates and frames. From three to five blotters are used in each section and care

should be taken that a fairly hard blotter is secured. This type of press is the same as that used in the final straining of transformer and other high grade oils and while it is necessary to use it in connection with the vacuum filter, the amount of fines removed is small. It may be said here that a considerable improvement may be shown in the oil by the insertion of a blotter press into any contact treating system, regardless of the type of filter used. It is the one way to be absolutely certain that no fines pass in the oil. In operating these presses at the high temperature one blotter is usually replaced in each section every 24 hours. As noted before the operating temperature of the blotter press should not be above 180°F. A higher temperature than this makes the blotters very brittle and materially cuts down their life.

Following are comparative costs between vacuum filtration and pressure filtration, on plants of a capacity of 1000 barrels per 24 hours, operating on a coastal red oil of a Saybolt viscosity of 75 at 210°F. An average of four per cent by weight of clay was used on this oil.

The vacuum filtration plant consisted of two 8 x 8 continuous rotary vacuum filters, or about 400 square feet of filter surface. The pressure filtration plant would consist of four No. 12 Sweetland filters.

Only those cost items chargeable to the filter operation are shown. Any other contact plant costs would be the same for either system of filtration. The costs are figured on a 300 working day year.

VACUUM FILTRATION

The filter unit will have 400 square feet of filter area. The base cost on this will be about $25.00 per square foot.

Investment:

$25.00 x 400	$10,000
Accessories—40% of base cost	4,000
Installation—25% of cost of equipment	3,500
Total Investment	$17,500
Daily charge @ 6% per year	3.50

Depreciation:

10% per year.

Daily charge	$ 5.83

Power:

Assuming power @ 1c per hp.-hr.
Power consumption 0.05 hp.-hr. per sq. ft. of filter area.

Power cost per 24 hrs.	$ 4.80

Labor:

One half man's time @ 50c per hr.

Labor cost per 24 hrs.	$ 6.00

Maintenance:

Monel filter cloth @ $1.50 per sq. ft. Life—2 yrs.	$ 1.00
Other maintenance—5% on total investment	$ 2.92
Daily charge	$ 3.92

The filter unit will have 1800 square feet of filter

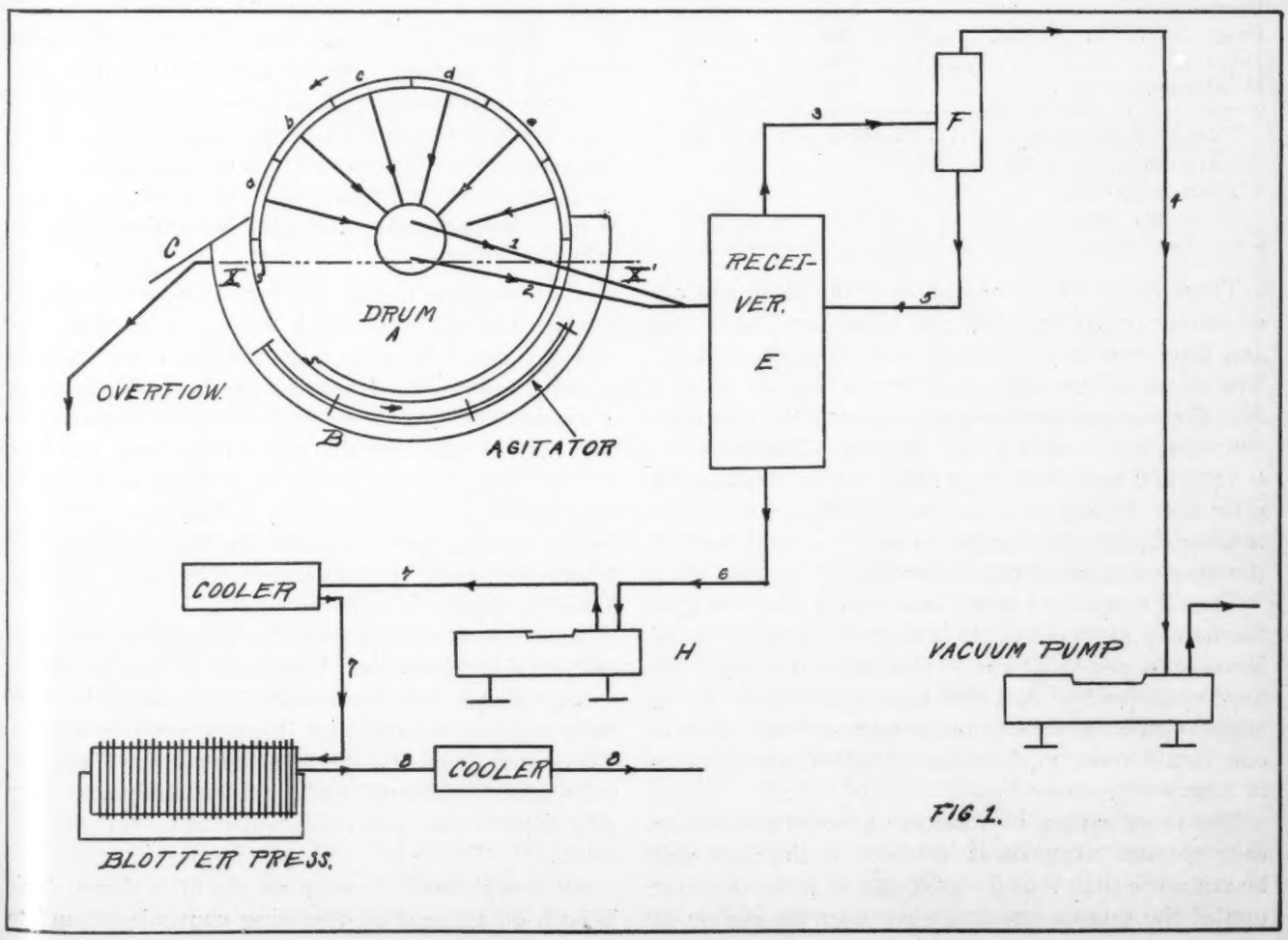


FIG 1.

surface. The base cost on this will be about $11.00 per square foot.

Investment:

$11.00 x 1800	$19,800
Accessories and Installation—40% of base cost...	7,920
Total Investment	$27,720
Daily charge @ 6% per year	5.54

Depreciation:

10% per year on total investment.	
Daily charge	$ 9.24

Power:

Power cost to be 1c per hp-hr.	
Power consumption—.01 hp. per sq. ft. of filter area.	
Power cost per 24 hrs.	$ 4.32

Labor:

2 men—full time @ 50c per hr.	$ 24.00

Maintenance:

Monel metal filter cloth @ $1.50 per sq. ft. Life 2 yrs.	$ 4.50
Other maintenance 3% per year on total investment	2.77
Maintenance—Daily charge	$ 7.27

SUMMARY OF DAILY COSTS

	Vacuum Filtration	Pressure Filtration
Investment	$ 3.50	$ 5.54
Depreciation	5.83	9.24
Power	4.80	4.32
Labor	6.00	24.00
Maintenance	3.92	7.27
Total daily filtration cost	$24.05	$50.37
At a production of 100-50 gallon barrels per day.		
Cost per barrel	$0.02450	$0.05037

These costs for the operation of the filter unit are of course rough but they are based on actual costs and filter flow rates and are entirely within reason. The cause of the difference in cost lies in the fact that the vacuum filtration is a continuous, thin cake filtration, which gives a high flow-rate. The labor cost is very low and there is no time out for discharging filter cake, drying the cake, etc. The thin cake is also responsible for the large saving of oil retained in the spent cake as it pulls very dry.

The oil considered here is one which does not give the best of filter cakes. It is viscous enough that an increase in the thickness of the cake cuts down the flow considerably, and the cake itself tends to be slightly gummy. Oils of lower viscosity and paraffin oils would show an increase in rate on both types of filters.

The large saving of continuous vacuum filtration over pressure filtration is in labor. If the filter unit be not more than four filters it can be so located that one of the regular operators can keep an eye on it. Of course, where the unit is located out of sight of the regular contact plant operations, or on another floor of the building a special operator will be required, but even then there is a large saving by vacuum filtration.

With this saving in labor there is also a saving in oil which amounts to an appreciable increase in yield. As was noted before, vacuum filtration is a thin cake operation, the cake running from one-eighth to one-quarter inches in thickness as against the three-quarters to one inch thickness of the pressure filter. This results in a much dryer cake coming off the vacuum filter. On an oil of a Saybolt viscosity of 75 @ 210°F. the vacuum filter will give a cake carrying from 20 to 25 per cent by weight of oil, as against 40 per cent and higher of the pressure filter. A dryer cake than this can be produced on a pressure filter only by longer blowing, with a considerable expenditure for compressed air, and even then the low figure of the vacuum filter can not be reached. Further, blowing time and dumping time are lost time so far as the filter operation is concerned. On the vacuum filter the oil flow is continuous; the drying and dumping being carried on at the same time at their proper sections of the drum.

Probably one of the first questions which will come to mind is: What about oxidation? Does not drawing air through the hot cake during the drying cycle cause a loss of color and quality of the oil? As a matter of fact the odor of the oil coming through a vacuum filter is much better than that from a pressure filter; all gaseous and odorous products being carried off and exhausted through the vacuum pump. The operation is of course carried on to give a satisfactory color at all times, and there is no indication that extra clay is required to maintain this color.

The exception to this satisfactory operation comes when a clay is used which forms a brittle, easily cracked cake. In this case sufficient air may be drawn through the cracks in the hot cake to cause a considerable loss in color. Some natural clays give this sort of cake, usually when they carry too high a proportion of coarse material. Foreign acid treated clays often give this trouble. In the case of the latter the matter can be remedied by finer grinding, and where necessary the importers will take steps to have this done.

Most American acid treated clays give a very good cake on a vacuum filter. Their cake is usually plastic enough that it does not crack easily, and at the same time is open enough that it gives good flow-rates. The general run of American natural clays are also satisfactory, although an occasional shipment may give a poor cake and oxidation due to cracking results.

No cover should be used on the filter drum. This is both on account of operating convenience and to

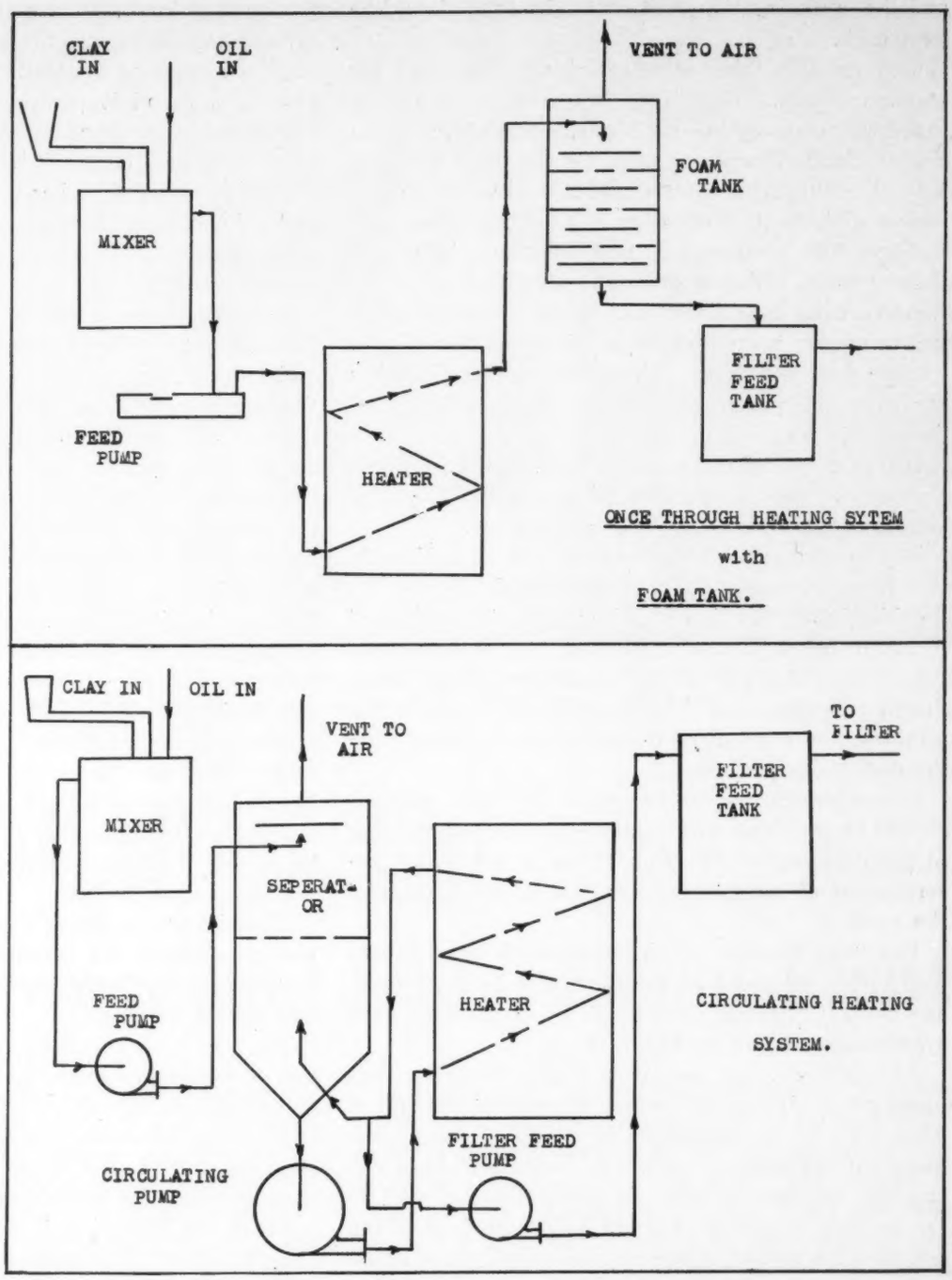


FIGURE 2

prevent any condensation of moisture which will be picked up by the clay and give a tight cake, which quickly plugs the filter cloth. Even at the temperatures at which contact filters operate, moisture is adsorbed by the clay, so that is far better on this account to run the drum in the open.

The principal difficulty in operating this type of filter comes from the cake and the filter cloth plugging and cutting down the filter rate. More attention, perhaps, must be paid to the cake on a vacuum filter than on a pressure filter, but there is nothing that can not be easily controlled. The causes of tight filter cake have been more fully dealt with in a previous article. The base of the trouble usually lies either in the clay itself or in the fact that moisture has been picked up.

Some natural clays may carry a high proportion of more or less colloidal fines. These, of course, will give a poor cake on any type of filter, but the effect is especially marked on a vacuum filter. The remedy is to change the clay or have it so graded that the fines are removed. Acid treated clays seldom give a poor cake from this cause. With such clays, in nine cases out of 10, trouble can be attributed to moisture. For this reason every effort should be made to get all the water out before the hot mix reaches the filter,

and the operating temperature of the filter should be kept high.

Care must be taken in selecting the filter cloth for vacuum filters. The high temperature of course makes it necessary to use Monel metal cloth, and a double dutch weave seems to be the most satisfactory. For this type of filter cake a twill weave or any weave with small grooves on the surface is unsatisfactory. The scraper does not peel the cake out of these grooves and they gradually fill with fines which literally bake into the cloth. With a double dutch weave or any weave which is fairly flat this sort of trouble does not occur. The scraper generally takes the cake clean from such cloth, and it cleans well during the washing operation.

In the discharging operation care should be taken that too much air pressure is not used. The cake should lift off as a whole and not in spots.

The drum should be washed periodically. Usually this is done once a shift, or every eight hours. To do this the suction is cut off and the drum allowed to run in the tank until it is clean. Air is sometimes turned into the top or drying section of the drum during this operation. The washing takes only a few minutes, and if required it can be done oftener than the eight-hour periods.

Filters which are to be used for this purpose should be provided with agitating arms which swing in the tank under the drum. This is to prevent the settlement of the heavier material to the bottom of the tank.

The filter system, which begins with the agitated feed tank just ahead of the filter, can be inserted in any contact filtration hook up. Two of the most used systems are shown in Figure 2.

As in all systems, special care must be taken that moisture is driven off before it reaches the filter. This may be accomplished by a vented foam tank filled with shelves or baffles, or better still by a circulating heating system. In the latter the feed to the heating system is sprayed on the surface of the hot oil. This results in the immediate release of moisture with little or no foaming. Where no circulation is used, where there is a single pass of the oil-clay mixture through the furnace, an excess of moisture with its sudden expansion will cause a sudden foaming which often goes through the baffled foam tank to the filter itself. Where it is necessary to use this type of tank it should be made as large as possible. Such a system is generally found where equipment already at hand is pressed into service, where the heater is not designed for circulation. Where a new plant or a new heater is built, a circulation system should be installed rather than a once-through heater and a foam tank. Experience has shown the former to be more flexible and give a much better removal of moisture.

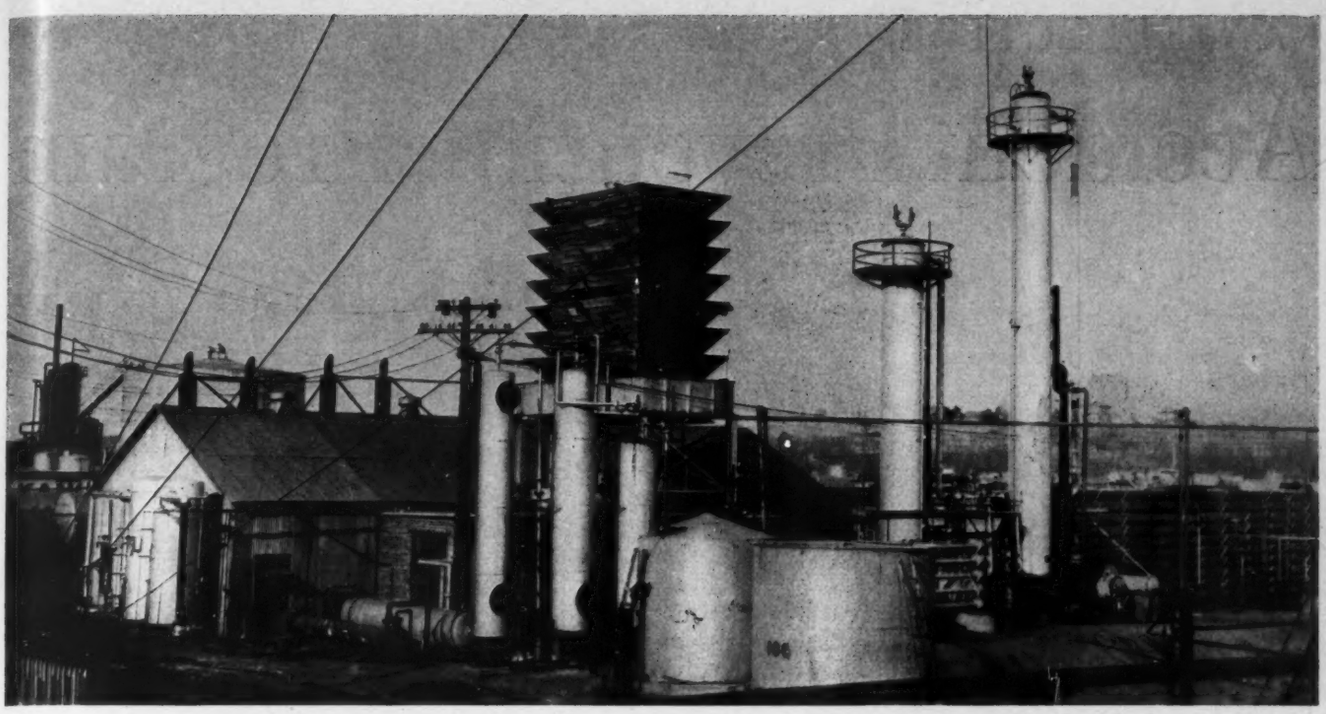
In starting the filtration it is necessary to circulate the hot oil-clay mixture through the filter tank and out the overflow until the system reaches filtration temperature, before the vacuum is put on the drum. The overflow leads back to the mixing tank ahead of the furnace in a once-through system or to the top of the separator in a circulation system. In the former case, care must be taken not to allow the temperature of this tank to get above the boiling point of water or bad foaming results. If this preliminary heating is not done, the cloth is likely to be plugged and the filter rate low from the start.

In the filtration of heavy stocks in naphtha solution it is doubtful whether any advantage can be found in vacuum filtration. Here the flow is high on either filter and there are decided advantages in keeping the naphtha under pressure rather than vacuum. The filter cakes in this operation are usually given a naphtha wash so that the oil content of the spent cake is low.

Closed vacuum filters could be used, but they are not satisfactory for contact treating, as eventually water builds up in the system until it plugs the cake and causes trouble.

Naphtha under a vacuum also means losses unless a recovery system is installed and this means complications. On the whole it is doubtful whether any saving of labor would balance the losses, and the cost and trouble of operating the extra equipment required for handling naphtha under a vacuum.

From the foregoing it will be clear that there is very much of a place in contact treating work for the vacuum filter, especially where the operation is large enough to be carried on 24 hours a day. The advantages and convenience of vacuum filtration is recognized in many fields and there is little doubt but that it will find its place in this one.



Kanotex Refining Company's vapor recovery and PD stabilizer units, showing compactness. Note chlorine warning flag-pole on top of the final fractionating tower.

Unusual Hook-Up

At Recovery and Stabilization Plant

IN the routine operation of its vapor recovery and pressure distillate stabilization units, Kanotex Refining Company, Arkansas City, Kansas, does not pull the uncondensed vapors from the run-down and finished product storage tanks. Instead of the usual method, a gathering system was laid to connect with the look box battery in the skimming unit, the pressure distillate receiving drums at the cracker units and the overhead accumulator at the pressure distillate stabilizer. Using this hook-up eliminates several sources of air infiltration. The vapors are pulled from their sources by a single cylinder 100-horsepower Clark gas engine-driven compressor at a vacuum of about one inch, mercury on the look boxes and receiving drums. The vacuum on the gasoline and pressure distillate coming through the condenser sections relieves the condensate of the lighter fractions and prevents them following with the streams to the receiving tanks and subsequently to storage.

Approximately 2½ million cubic feet of vapors are handled each day through this procedure. The discharge of the single stage compressor through which the initial volume of vapors are passed is held at 15 pounds, passing the gas through condenser sections to liquefy a portion of the heavier fractions contained in the vapors. The liquefied product of this operation is received in an accumulator tank and drawn away as produced to a common blending tank. The residue is pulled over to the low pressure side of the two twin compressor units, boosted up to 45 pounds and cooled a second time to condense another part of the vapors. The remaining portion still uncondensed is taken from this accumulator vapor line to the high compression side of the compressor and boosted through the third stage of compression to 305 pounds.

Passing directly to the fractionator uncooled, this high stage gas is led through an insulated line to the nineteenth tray of the tower. This column, 4 x 57 feet, contains 30 trays, 19 of which are strippers and the upper 11 the fractionators. Co-incidental with this operation, the pressure distillate is pumped to the stabilizer column where 15 per cent of the original charge is removed as an overhead product; enough to provide the bottoms with an A.S.T.M. initial of 120° F. To provide for the two cuts, overhead containing isobutane, butane and lighter fractions, and the stabilized

(*Continued on page* 407)

AN EFFECTIVE Accident Prevention Program *for* Refinery Operation

W. P. REYMOND, JR.
Safety Engineer, Standard Oil Company of Louisiana

Presented before Petroleum Section 22nd Annual Safety Congress, Chicago, October 5, 1933.

SINCE organized safety work was inaugurated in industry, 22 or more years ago, great strides have been made and much good has been accomplished in the prevention of accidents. Every industrial organization of any consequence in the world today recognizes that in order to survive its business must be conducted along efficient lines—and since no operation may be considered efficient unless they are conducted safely, it will be seen that safe practices should be adopted universally.

Efficiency and safety go hand in hand. The accomplishment of the first is entirely dependent on the accomplishment of the second. Unless a job is done safely, it cannot be said to have been done efficiently.

An executive of a large oil company, writing of his company's efforts and desire to prevent accidents, says:

"Because accident prevention work is essentially humanitarian, it is not to be inferred that a special claim to virtue is made for the company on that score. The work has another aspect strictly in accord with the practical aims of industrial activities: Betterment of working conditions, wrought through a lessening of hazards of physical injury to workers, invariably raises the morals of the personnel and increased efficiency results. Thus, regarded from either viewpoint, it is good business."

With the rapid changes being effected daily in the methods of oil refining, I know of no line of manufacture where the need of an effective accident prevention program is more apparent. The success of such a program is dependent upon the full cooperation of all agencies in the refining organization: that is, the management, the foremen, the mechanics, and the rank and file of the employes. Cooperation is the keynote to such a program's success, and the measure of its success will depend on each agency in the organization doing its full part in furthering the prevention of accidents.

While it is essential that refinery equipment be safely designed, adequately safeguarded, properly maintained, and systematically inspected, it is of equal importance that all duties in connection with the operation and maintenance of the equipment be performed in strict accordance with safe practices. No equipment is safe unless it is properly operated, and that means safely operated.

The entire personnel of a refinery must be made familiar with the safe methods of performing their duties. Men must be safeguarded from avoidable accidents, and must have instilled into them an active interest in accident prevention. It is for the accomplishment of these purposes that every agency in the refinery must be coordinated into an effective accident prevention program.

I shall endeavor to outline to you the details of a plan which, if diligently and enthusiastically applied, should result in real progress being made in the prevention of accidents in an oil refinery.

Accident prevention work must begin at the top. The management must show its interest in it and make accident prevention a necessary part of production. It must stand behind safety so firmly and actively that every foreman and workman will feel the management's support. Its purpose to retain no employes who fail to cooperate in the movement must be made known.

In every refinery, no matter how small, one man should be made responsible for the safety of personnel. In a refinery of large enough size, this man should devote his entire time to the promotion of safety and should be designated either as safety director or safety engineer. I shall refer to him hereafter as a safety director.

The safety director's qualifications should include those that are found in most successful men in various walks of life. He should be a man of vision, a man with initiative, persistency, diplomacy, leadership, and (above all) sympathy. Furthermore, he should have a background of training that fits him for safety work. This training should include sufficient experience in refinery operations to give him a general idea of the detail workings of all refining operations.

The safety director should know the men he is work-

ing for and with, for much depends upon his manner of contact with men and management alike and his ability to secure their cooperation. While the responsibility is placed on him for the safety of the employes in his organization, he must be able to delegate this responsibility to the foremen, supervisors, and gang pushers. Each foreman or supervisor is—or should be—responsible for the safety of his men, and each gang pusher, likewise, is—or should be—responsible for the safety of those who work with him.

With the full cooperation of the management, the following program of activities should be effected and supervised by the safety director:

1. General safety committee.
2. Workmen's safety committee.
3. Foremen's inspections.
4. Investigation of accidents.
5. Formation, adoption, and enforcement of safety rules.
6. An educational program.

THE GENERAL SAFETY COMMITTEE

The general safety committee should be appointed by the management and should be composed of foremen representatives from all of the principal refinery departments. Their terms of service as members of this committee should be limited preferably to six months, after which a new set of foremen should be appointed. In this way, all foremen will have the opportunity, sooner or later, to become actively associated with an important factor in the promotion of accident prevention.

The safety director (or the superintendent, if he so elects) should serve as chairman of this committee at meetings held at least bi-weekly. At these meetings all matters pertaining to safety should be discussed, including reports of serious, minor as well as disabling injuries. Reports of foremen inspections should be read and each item referred to the committee member who is most concerned by it. This part of the committee activities will be dealt with later.

The members of this committee should be encouraged to state their opinions freely and to make suggestions that they may consider essential in furthering accident prevention. They are the safety representatives of their respective departments and, as such, should take a strong and particular interest in the elimination of accident causes and in the stimulation and maintenance of an active interest in the safety activities in their departments.

WORKMEN'S SAFETY COMMITTEE

The workmen's safety committee should be composed of workmen representatives from the principal refinery departments. They should be appointed by their department foremen to serve during a two or three-month period. With this committee rotating its membership every two or three months, a majority of the workmen will, in time, have an opportunity to serve with it.

This committee also should meet bi-weekly, with the safety director (or, preferably, his assistant) acting as chairman. As in the case of the general safety committee, the members of the workmen's safety committee should be encouraged to express themselves freely about safety matters and to make the most of opportunities afforded them to take active parts in the accident prevention program.

It has been our experience that when workmen feel that they are given recognition and responsibility along safety lines, their interest in the work is increased. In plants using such committees, it has been found that a large percentage of the workers' suggestions are practicable and worthy of adoption.

At each workmen's safety meeting interesting topics should be discussed. A short talk by the chairman or an invited guest adds much to the success of the meeting. Every effort should be made to demonstrate to the committee members that the management fully appreciates their work and interest in safety and that suggestions that will tend to improve conditions within the refinery not only are welcomed but are desired.

FOREMEN'S INSPECTIONS

Every week, two foremen from the general safety committee should be assigned to inspect one or more refinery zones. Such inspections should include close observation of all unsafe conditions and practices, insanitary conditions, poor housekeeping, the need of safeguards, and the need of improvement in the zone.

The reports of inspections should be sent promptly to the safety director. Afterwards they should be read and discussed at the meetings of the general safety committee. Once the items mentioned have been assigned to the foremen most concerned, for their attention, it is highly important that a follow-up be made to ascertain that the necessary corrective steps are taken at the earliest possible time.

A very effective plan covering foremen inspections recently has been instituted in some refineries and has resulted in the accomplishment of much good. Each week, a foreman or supervisor is appointed to serve as safety inspector in the refinery. He is privileged, in this office, to visit any part of the refinery and is expected to cover as much of it as possible during the time designated for this service. He acts as a safety detective, in that he looks carefully to discover any practices and conditions that are unsafe. He acts also as an instructor, diplomatically advising and correcting any workmen who are not following the proper and safe methods of performing their jobs.

This inspection system, in addition to providing a means of discovering and correcting unsafe practices, proves beneficial to the safety inspector by allowing him to come in closer contact with the actual work of accident prevention. The experience a man gains from his inspection duties gives him an improved insight into

the problems of other departments and so broadens his knowledge of the refinery as a whole. For these reasons he is better fitted, once his inspection responsibility is terminated, to handle his regular duties.

Despite all efforts to the contrary, unusual occurrences or accidents frequently result in injuries to workmen. When an accident occurs, an immediate investigation should be made to establish the cause of it and to find out where the blame should be placed. At the same time, necessary corrective measures to prevent a recurrence should be ascertained and the proper corrections immediately put into effect.

An accident investigation should be made in each case by the department in which the accident occurred and also by the safety director, who, as soon as the department foreman's report is received, should prepare a final report based on information gained from both investigations. As unfortunate as accidents sometimes prove to be, there are always valuable lessons to be learned from them. Unless corrective measures are immediately put into effect, however, there follows the possibility of a similar happening, the result of which none can tell. We must ever bear in mind that the severity of an injury is beyond human control: a minor occurrence often will cause no injury at all. For this reason, every unusual occurrence, regardless of its consequences in injuries, should be investigated and studied, so that the necessary preventive measures may be adopted.

It is the duty of the safety director to definitely fix the cause of each accident and, if possible, render an unbiased opinion as to the responsibility for it. When this responsibility clearly shows that disciplinary action is justified, this action should be initiated by the department head or the management, never by the safety director. The latter must secure and maintain the good will of all employes, for only by the cooperation which results from this feeling can he expect to attain success in the prevention of accidents.

FORMATION AND ENFORCEMENT

Rules should be adopted which, in the judgment of the management, the safety director, and the foreman, will best protect the refinery workmen from accidental injuries. Absolute accident prevention cannot be learned in one lesson, nor in several lessons; it must be studied constantly and be revised to meet new conditions as they arise.

Safety rules should include:

1. Instructions outlining the safe and efficient methods to be followed by the various crafts in performing their everyday duties.

2. Instructions outlining the safe procedure for conducting refining operations.

3. Instructions outlining the procedure for adequately preparing refining equipment for inspection, maintenance, and repair work.

4. A system of written permits for issuance by authorized process foremen allowing hot work or work on and near equipment that has been in service.

5. Instructions regulating the personal conduct of employes and the use of necessary safeguards.

To have accident prevention successfully promoted, safety regulations must be enforced. An army cannot hope to reach its objective unless there is obedience in the ranks to the instructions of "higher-ups"; and by the same reasoning the prevention of accidents will not be accomplished unless safety instructions are carefully followed. It is the duty of all foremen and supervisors to see that safety instructions are fully complied with.

The foremen are the key men to safety in that they must see that safety rules are obeyed and that all operations are carried on strictly in accord with safe practices. A single violation of a safety rule does not necessarily cause an accident, but continued violations will ultimately result in one and it is therefore the duty of foremen to see that safe practices are followed at all times.

The attitude of the average workman towards safety depends largely upon the attitude of his foreman. If his foreman is "sold" on safety, and shows his men by careful instruction and supervision that he is trying to protect them, he will have little trouble in building up safety in his department.

Minor infractions of safety rules should bring reprimands, and more serious violations should call for suspension from work. Serious workers who realize that safety rules are made for their own benefit will gladly cooperate with the management by observing them.

EDUCATION

This phase of the program is designed to inculcate in the rank and file of the workers the habits of caution, and to convert the habitually thoughtless or indifferent employes into consistently careful workmen. Safety work, guarding, and expenditures for safety go mostly for naught unless the man on the job understands and follows the requirements for safely performing his duties. A continuous educational program must be maintained.

This educational work is an important part of the safety department's duties and must be vigorously promoted. Foremen and supervisors should be made to realize that the safe performance of plant operations is a necessary part of their work, and that the safety of their men is more important than the progress of the job. A foreman who countenances unsafe practices in his department is not an efficient foreman and should not be permitted to continue in such a capacity.

A necessary part of any educational program must train the foremen, who, in turn, must train their men. The conference method of improving foremanship, as conducted under the auspices of state departments of industrial education, provides an excellent medium for foreman education. This conference training brings about a better understanding of the duties of foremanship and enables foremen to learn how to correctly rep-

resent the company to their men and how to direct their work in an intelligent and safe manner.

A foreman, being the one through whom all transactions pass from the company management to the workman, and vice versa, is a most important leader. The company looks to him for efficient and economic production, for the promotion of loyalty, company spirit and harmony, and (above all) the protection and safety of employes.

This conference method of training brings out an exchange of ideas concerning the duties of foremen in such a manner that each one benefits by the ideas of others. This exchange of ideas, which are based on the experiences of individuals throughout the plant organization, is one means of bringing about a better understanding and relationship between the company and its employes.

In the promotion of an educational program in safety, a variety of methods have been created and the safety director must use his discretion in selecting methods best adapted to the personalities of individuals with whom he works.

Reports showing comparative records of department and company accident experiences, serve a useful purpose by informing the refinery personnel of the progress of their plant and each department in accident prevention. The circulation of reports of accidents, showing responsibility and corrective measures taken is of great value in the educational program.

Safety posters, conspicuously placed about the refinery, and frequently renewed, are most effective in arousing and maintaining the employes' interest in the prevention of accidents.

A refinery publication or news letter, issued at regular intervals, affords a good medium of publicizing safety information and makes a strong appeal to the workman.

The petroleum industry is fortunate in having available the services of the United States Bureau of Mines in first aid training. This training is a wonderful help in leading men to prevent accidents. It has been seen that the workman who is trained in first aid better understands the effects of accidents, and this is probably because of his knowledge of the care necessary in rendering first aid relief to the injured. Every refinery employe, in my opinion, should receive this course of training.

IMMEDIATE TREATMENT

Immediate treatment for minor injuries is most important and every employe must be trained to seek the proper attention when hurt. Many infections and, later, serious developments may be prevented by the correct treatment of minor injuries. Fortunate is the refinery that is equipped with a modern first aid hospital, where all minor injuries may receive immediate medical attention.

Some refineries have organized chapters of the Holmes Safety Association which are supported by their employes. These organizations provide means of education and entertainment for their members and others. They sponsor and promote accident prevention work in their plants, their homes, and their communities as well. The inculcation of safety consciousness in a man's home is an important factor having to do with his actions on the job, and it has been shown that an active chapter of the Holmes Safety Association contributes to more rapid progress in accident prevention wherever it serves.

Through the National Safety Council and the accident prevention department of the American Petroleum Institute, publications, manuals, safe practice pamphlets, safety instruction cards and other educational literature are available. This material, intelligently circulated, provides an effective means of further educating refinery personnel in safe methods.

Interest in safety must be kept aroused, must not be allowed to slump. Competition in accident prevention is one valuable means of arousing and sustaining safety interest. Discipline, law, and enforcement are important, very important, but much more can be accomplished in safety by getting workmen in a frame of mind to work safely. He is a safer workman who desires to work safely.

Safety contests and other forms of competition afford means of encouraging refinery employes to practice greater safety. The annual safety contest sponsored by the National Safety Council stimulates considerable employe interest. The competitive spirit, whether it be found in sport, business, or in safety, always finds response in American hearts, and workmen appear to show more interest in safety as a result of competitions along that line.

An inter-departmental safety contest, wherein every department competes for an annual trophy, provides a good incentive. In a large refinery, it may be desirable to divide the departments into two contest groups, mechanical and process. In this way, each department will be competing against others whose activities are of a comparable nature.

In order to keep interest alive in these competitions, as much publicity as possible should be given them. A contest between departments makes a "game" of accident prevention and gives the workmen a common interest in something about which they can talk and about which they can develop and display enthusiasm.

The program must be designed, planned, and executed to inculcate into the minds of all employes a constant feeling of safety-consciousness. Every foreman and every workman must be trained to think, and must, before attempting to perform any task, be trained to ask themselves, subconsciously, whether they have outlined the safe procedure, whether the necessary safeguards are being used, and whether all necessary precautions are being followed. When this achievement becomes a reality it may be said truly that the program has become effective.

A New Deal *for the* Petroleum Industry

JOSEPH E. POGUE

Before National Petroleum Association, Annual Meeting, Atlantic City, September 22, 1933

ANOTHER milestone has been passed in the life history of the oil business and an unknown road is now to be traversed. The signing of the Petroleum Code of Fair Competition by the President of the United States brings this industry under the authority of the National Recovery Act and imposes new responsibilities upon every participant in the management of the petroleum resource. *A Code of Fair Competition*—the very title implies that there are forms of competition that are unfair and these are outlawed, but the implication is no less clear that fair competition will continue and there are few who would have it otherwise.

The petroleum code lays down a new set of rules for the conduct of the oil business. In essence, the code consists of three groups of provisions and objectives, as follows:

(a) Regulations governing hours of labor and rates of pay, planned to increase the purchasing power emanating from the industry.

(b) A production control designed to be an improvement over the system of proration already developed in the industry and intended to bring about and maintain a balance between crude oil supply and consumer demand for petroleum products, with consequent stabilization of the industry.

(c) An extensive series of marketing rules largely concerned with the standardization of marketing practices in the distribution of petroleum products, with the avowed purpose of eliminating undesirable forms of competition.

The labor and marketing aspects of the code are directed toward objectives with which no doubt everyone will find himself in agreement, but it must be clear that little can be accomplished in these directions unless the production control is soundly conceived and effectively administered. Fundamentally, therefore, the new deal for the petroleum industry centers around the mechanism for the attainment of economic equilibrium.

A production control in the oil industry, however, is nothing new. Proration as a means for balancing supply and demand had its inception seven years ago in the Seminole district in Oklahoma, whence the practice gradually spread until it came to pervade the operations of practically the entire industry. Instigated as an expedient to cope with localized overproduction, the artificial limitation of supply was at first a cooperative movement, but it was not long before the conservation laws of several of the oil-producing states were invoked and elaborated, and finally proration became institutionalized and legalized. Nevertheless it brought neither stability nor prosperity to the industry. Wherein did it fail?

(a) Proration failed to retard oil field development and hence under the practice the potential supply of crude petroleum increased enormously, building up pressure on the markets. This outcome was greatly accentuated by the untimely discovery of the great East Texas field and the existence of a special form of property rights affecting oil leases.

(b) While alleviating to some degree the competition between fields and among the leases of a single field, proration left relatively unimpaired the economic rivalry between states. No mechanism was afforded for definitely limiting state contributions to interstate commerce.

(c) Proration developed no effective technique for balancing supply with consumer demand, contenting itself with directing its efforts toward equating supply to buyers' demand, a very different objective. In consequence there was little to stop periodic overmanufacturing of gasoline; which repeatedly took place, in fact regularly during rising phases of the price cycle.

Let us now examine what the code offers in those particulars in which proration was lacking.

In the first place, the code provides a rule that all new fields are to be developed according to a plan approved by the President. This provision affords a means for slowing down the development of new pools at times when flush oil is not needed, but the economic consequences of this rule will depend upon the manner in which it is administered and the degree to which it may be enforced. The outcome, therefore, cannot be clearly foreseen, but there are inherent potentialities of significance.

In the second place, the code provides a mechanism for coordinating the output of the several states so as to prevent the unfair invasion of trade channels by any single state. The authority for such control is derived from the right of the federal government, both under the Constitution and the National Recovery Act, to regulate interstate commerce; and the method for

achieving that end lies in a system of state quotas to be determined by a federal agency. The advantages of a central determination of production quotas is obvious, provided the pitfalls of political pressure are avoided and allocations are made in the light of technical studies and without favor. The provisos, however, will be recognized as important; and furthermore an improvement in existing technique should be sedulously sought.

In the third place, the code definitely gets away from the fallacy of aiming at a mere balance between crude oil supply and demand, and specifies a "balance between crude oil supply and the consumer demand for petroleum products." The wording of the code in this respect is of paramount importance, and in addition means are provided for checking speculative movements in refinery operations.

Whether these points of advance over the practice of proration as heretofore followed are sufficient to bring sustained stability to the industry will be watched with interest. There are unanswered questions of both theory and practice to be considered. At least, however, those charged with the administration of the production control have a responsibility to administer it with all the skill and disinterestedness that can be commanded.

During the code hearings and discussions the matter of price-fixing was a live issue and certain price-fixing provisions were included in the code. With no desire to prolong this discussion, it may nevertheless be said that production control offers a clearer road to stability than a governmental guarantee of price. To many close students of production control it is apparent that a free price structure is the only alternative to a degree of pervasiveness in regulation that could scarcely be accomplished without greatly vitiating the autonomy and initiative of the competitive units now engaged in the business. Price is both a cause and an effect; and its casual function is needed so long as we operate under a competitive price system.

In short, the new deal provides the oil business with a production control that as a mechanism is superior to proration as heretofore practiced. The device carries important potentialities but much depends upon the manner in which it is handled and developed. The problems to be met are many and varied, involving not merely matters of technique but of political economy as well. The months ahead promise to be particularly interesting ones, for the oil industry will doubtless become a key example in the field of planned economy.

Unusual Hook-Up at Recovery and Stabilization Plant

(*Continued from page* 401)

bottoms, the reboiler is carried at a temperature of 270° F. and the top of the tower is maintained at 155° F. The overhead temperature is maintained by pumping back to the top of the tower a portion of the condensed overhead as reflux. That part of the condensate not needed is pumped to the common blending tank to mix with the product of the first and second stage of compression in the vapor recovery unit. It is picked up from this point and charged to the fractionator at the same point where the residue or vapors from the third stage of compression enter.

The blended feed, composed of the first and second stage compression and the tops cut from the pressure distillate removed from the stabilizer, are fed through the exchangers in the fractionating unit at a temperature of 230° F. and under an entrance pressure of 300 pounds, all mixed with the residue gas from the third stage of compression. That portion of the feed falling through the 19 trays enters the reboiler and is heated to 290° F. to drive the iso-butane and lighter fractions from the product. The top section of the fractionator is maintained at 155° F. with wet reflux, a temperature which provides a bottom product with a vapor pressure of 30 pounds Reid. The reflux, condensed again as it is taken from the top of the tower, is cooled to 90/95° F. and fed back to the column. The combined product passed through the fractionator as finished 30-pound bottoms, are treated in a continuous hypochlorite system preceded by a caustic wash to eliminate hydrogen sulfide. Corrosion from this source is sometimes serious, and when air enters with the vapors, breaking down the hydrogen sulfide, the gasoline produced is treated with doctor solution to produce a sweet and non-corrosive blending gasoline.

In the treating side of the operation, when a fresh solution of hypochlorite is being mixed, precautions are taken to prevent persons passing through the zone of possibly chlorine contaminated atmosphere. Before the drums are connected to the chlorinating tanks, a red flag is run to a pole placed upon the top of the fractionator column. To supplement this warning which all may see, red barriers are placed across the walks and roadways leading around the unit and across the switching track of the railway spurs. No casualties have occurred from contact with the chlorine vapors and if those who are not directly connected with the hypochlorite mixing observe the flag and barriers, they will not enter or cross that part of the plant. The stillmen who operate the chlorinating system are required to wear gas masks from the time the drums are placed on the scales until all connections have been dismantled and valves tested for leaks. This system of advertising to the employes that chlorine is being mixed is somewhat unusual, and serves its purpose admirably.

A. P. I. Annual Meeting

Preliminary Program, Fourteenth Annual Meeting, Refining Sessions, of American Petroleum Institute, Stevens Hotel, Chicago, October 24, 25 and 26, 1933

Tuesday, October 24, 1933
Morning—10:30 a.m.

Meeting of Board of Councillors:

To nominate candidates for election as members of the board of directors.

Afternoon—2:30 p.m.

General Session:

The President's Address.

Axtell J. Byles, American Petroleum Institute.

Report of Board of Councillors and Election of Directors.

Presentation of Accident Prevention Certificate Awards.

Progress of the American Petroleum Industries Committee.

Wednesday, October 25, 1933
10:00 a.m.

General Session:

Address—Hon. Harold L. Ickes, Secretary of the Interior, and the Oil Administrator.

Address—Wirt Franklin, Chairman, Planning and Coordination Committee.

DIVISION OF REFINING
Wednesday, October 25, 1933
2:00 p.m.

Solvent Refining:

Presiding: L. W. Parsons, Tide Water Oil Company.

"Solvent Extraction and Its Application"—J. W. Poole, and J. M. Wadsworth, Foster-Wheeler Corporation.

"Refining of Lubricating Oils by Solvent Extraction with Furfural"—R. E. Manley, B. Y. McCarty and H. H. Gross, The Texas Company.

"Scope and Flexibility of the Edeleanu Processes"—O. P. Cottrell, The Edeleanu Company.

"The Nitrobenzene Process—Installation and Operating Costs"—S. B. Ferris, W. A. Myers and A. G. Peterkin, The Atlantic Refining Company.

"Chlorex Process for Producing High-Grade Lubricating Oil"—W. H. Bahlke, A. B. Brown and F. F. Diwoky, Standard Oil Company (Indiana).

"Relation of Duo-Sol Process to Other Processing Steps Necessary for Lubricating-Oil Manufacture"—Malcolm Tuttle and Max B. Miller, Max B. Miller Company.

"The Use of Phenol as a Selective Solvent in the Production of High-Grade Motor Oil"—R. K. Stratford, O. S. Pokorny and J. K. Huggett, Imperial Oil Refineries, Ltd.

Thursday, October 26, 1933
10:00 a.m.

Refining Session:

Presiding: H. W. Camp, Empire Oil and Refining Company.

"Production of Contact Sulfuric Acid from Refinery Acid Sludge"—S. F. Spangler, Chemical Construction Company.

"Chemical Constituents of Petroleum (A.P.I. Research Project 6)"—E. W. Washburn, U. S. Bureau of Standards.

"Twenty Years of Research in Petroleum"—A. E. Dunstan, Anglo-Persian Oil Company.

"Fundamental Factors Governing the Design of a Vapor-Phase Cracking Coil"—H. C. Schutt, Alco Products, Inc.

Motion Picture: "Coke Production by Knowles Oven".

"Report of Division's Nominating Committee"—W. W. Lowe, Henry L. Doherty and Company, Chairman.

Election of Twenty Members of the General Committee of the Division of Refining.

DIVISIONS OF REFINING AND MARKETING
Joint Session
2:00 p.m.

Automobile Operation:

Presiding: E. W. Isom, Sinclair Refining Company.

(This topic is divided into two parts: Part 1—How Can the Petroleum Industry Help the Automotive Industry? Part II—How Can the Automotive Industry Help the Petroleum Industry? A general discussion of the common problems of the two industries will follow the presentation of the main features of the papers.)

Part I

"Motor Fuels"—J. B. Macauley, Jr., Chrysler Corporation.

"Automobile Passenger-Car Motor-Oil Recommendations"—W. H. Graves, Packard Motor Car Company.

"Chassis Lubricants"—H. C. Mougey, General Motors Corporation.

Part II

"How the Automobile Industry Can Help Itself by Aiding the Petroleum Industry"—A. Ludlow Clayden, Sun Oil Company.

"Effect of Automotive Design on Vapor Lock"—O. C. Bridgeman, U. S. Bureau of Standards.

"What the Automotive Industry Can Do to Help the Petroleum Industry"—J. F. Winchester, Standard Oil Company (New Jersey).

Modernization *Increases Capacity and Efficiency* At Bell Plant

BELL OIL & GAS COMPANY, Tulsa, operating a refinery at Grandfield, Oklahoma, completed a program in June which included remodeling and revamping of the Dubbs cracking unit, changes in the skimming facilities and the erection of a vapor recovery and pressure distillate stabilizing plant. Previous to this modernization program, the throughput of fresh crude was in the neighborhood of 2000 barrels per day, and only about 1000 barrels of reduced crude was fed to the cracking unit which was operated on the non-residuum process. When the renovation was completed, the crude charge to the skimming plant was raised to 3500 barrels, and the charge of reduced crude to the cracking unit was raised to 2000 barrels per day, operating with fuel oil as residuum.

After the Pampa crude has been processed through the skimming plant to 26.5° A.P.I., this cold residuum as topped crude is charged to the remodeled cracking unit, delivered directly to an open type heat exchanger. This exchanger is the old Dubbs dephlegmator set in the original position on the steel tower originally erected for this purpose. Entering near the top of the exchanger, the topped crude charge flows down counter-current to the vapors in the cracking process, leaving at the base of the exchanger and entering the new 7x65-foot Wyatt bubble tower. This tower, containing 17 bubble trays, is set on a concrete foundation in the dephlegmator tower. A base section 17 feet in length under the bubble trays receives the crude as it leaves the exchanger, while the vapors from cracking and those driven from the reduced crude enter this tower in the bubble tray section.

Liquid from the base of this bubble tower is picked up under 50 pounds pressure by a Worthington hot oil pump, 5½x18, and charged to the tube still for cracking. A novel feature of this installation is the pump drive. Ordinarily either a cross compound steam engine drives the pump, an electric motor or gas engine is set to deliver the driving power. In this set-up a Worthington full Diesel solid injection internal combustion engine is utilized. This engine is a Type CAT-8, No. VO-875, 200 horsepower four-cylinder variable speed power unit, ranging from 100 to 360 revolutions per minute under a full load. Operable on any kind of liquid fuel, it is being run on 40 gravity distillate. At the time of installation, it was the second of its kind in use, one other being installed previously in a refinery at Kansas City.

Two reasons were advanced for the installation of this type of hot oil pump drive, one being the scarcity of desirable boiler water, and the other the uncertainty of continuous delivery of electricity. During the period of the year when electrical storms are prevalent, power may be shut off.

A separate building houses the engine and pump with a dividing wall between the two. A 4½-inch shaft connects the two units with a Fasts flexible coupling installed near the fly-wheel of the engine and another at the reduction gear box of the pump. These couplings compensate for any inequality in the driving alignment of the shaft.

A closed circuit water-cooled system using condensed steam for make up, circulated by a 2-inch Westco centrifugal pump is driven by a belt from the flywheel of the engine. The water circulates through the jackets of the engine and a bank of Burrell-Mase 18 gauge admiralty metal sections placed in a cooling tower served by Marley spray units.

From this hot oil pump the oil in process is pumped at 650 pounds discharge pressure to the furnace. This unit, a revamped Lientz type, contains 104 four-inch Calorized tubes with ⅜-inch walls, 33 of which are placed in the roof with the others set in the wall sections. Key boiler headers are installed in the furnace. A solid wall fabricated from fire brick was built with a Deitrich arch placed in the combustion chamber. Lientz recirculating fans driven by a 20 horsepower English Brothers vertical steam engine, serves the Lientz burners firing the furnace combustion chamber.

From the transfer line, the oil at 920°F. is introduced at 450 pounds pressure through an insulated line containing Midwest pipe bends to a tower 4x40 feet, having a wall thickness of 3¾ inches. This type of tower is not essential to the operation of the unit, but having an opportunity to purchase it at

almost salvage price, it was installed in preference to a lighter one. Falling downward in this open column through a wall washer, the oil under 300 pounds pressure is removed from the base to enter at the top of the original Dubbs reaction chamber. The 300 pounds pressure is reduced to 150 pounds before entering this original column by a Stockham steel valve equipped with stainless steel trim. In the reaction chamber, now called the flash tower, the oil under 150 pounds pressure is drawn away to a stripper column set under the dephlegmator tower and contains 12 stripper decks. The stripper column, 4x30 feet, separates any vapors from the finished fuel oil which is drained from the base to coolers and storage. This bottom product runs from 10 to 12 gravity with a 35°F. cold test having a Furol viscosity of 35 and containing one per cent of BS&W. The flash point is maintained at 300°F. and the fire at 350°F.

Vapors from the cracking operation other than that separated in the stripper column leave the flash chamber at the top through a six-inch insulated line to the open type heat exchanger to contact the cold crude charge. Leaving this exchanger, the vapors enter the Wyatt bubble tower (insulated with Eagle-Picher rock wool) for fractionation for end point. An overhead line carries the pressure distillate vapors to submerged Burrel-Mase condensor sections where they are condensed and received in the accumulator drum.

The top of the bubble tower is controlled for 400° F. end point product through reflux pumped back over the column. The amount of reflux is controlled by a Leeds & Northrup Micromax instrument operating a Beck control mechanism which is set on a Neilan 1¼-inch control valve. Bottoms from the bubble tower constitute the hot oil and recycle feed, the ratio being 2½ to 1.

The liquefied pressure distillate is processed through a Burrel-Mase combination vapor recovery, pressure distillate stabilizer and gasoline finisher controlling the Reid vapor pressure at 6 to 12 pounds depending upon the sales specification of the finished motor fuel. From this unit, the finished pressure distillate is carried to storage where it is treated with one gallon of gum inhibitor to 8,000 gallons of pressure distillate, reducing the gum content of the liquid to 14/20 milligrams by the copper dish test without affecting the 74 octane value.

From the topped crude charge fed to this remodeled unit, 55 per cent is recovered as 400 end point gasoline. Ten per cent is lost through fixed gases used as fuel under the cracking furnace and boiler.

Another feature of the recovery and stabilization unit is the use of heat taken from the bubble tower. A stream is removed from the seventh deck and passed through the reboiler to accomplish the results usually requiring steam. After the exchange of heat in the stream from the seventh deck to the bottom in the fractionating tower, this cut is returned to the top of the bubble tower to supplement and reduce the amount of reflux pumped back to control the end point of the pressure distillate. Steam is not used in this system except process steam in the vapor recovery still and to drive the charge and reflux pumps.

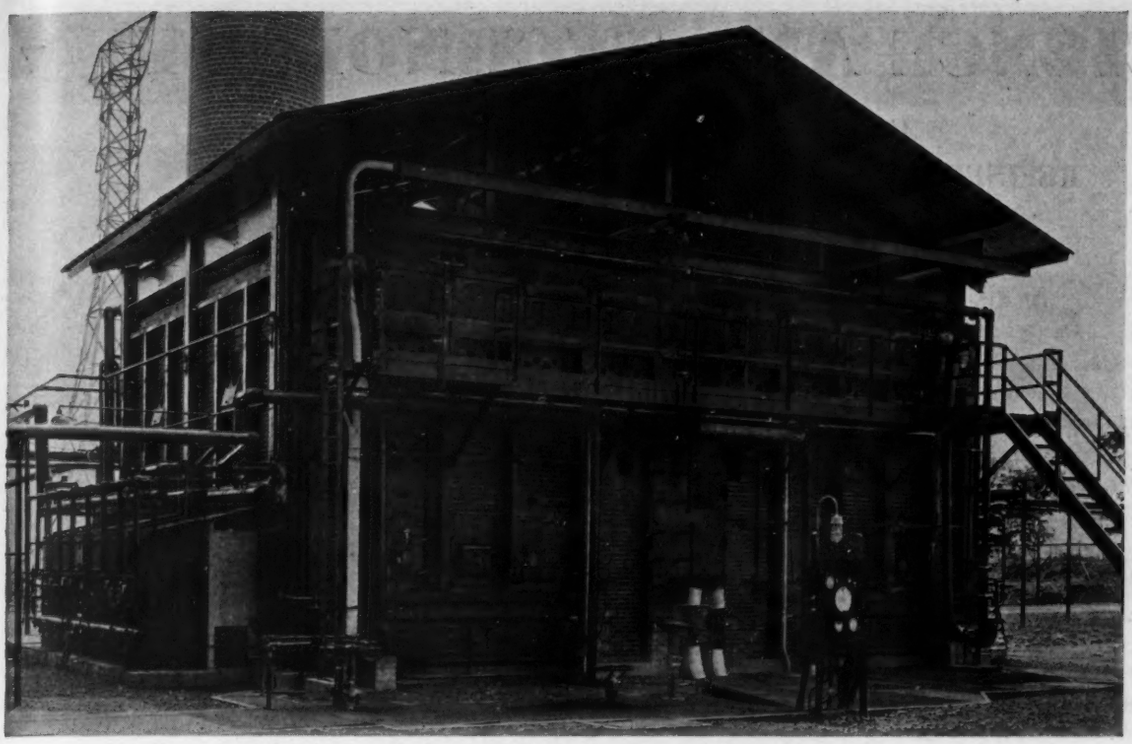
Relieving Pumps of Vapor-Lock

PUMPS, when handling high gravity raw natural gasoline often have a tendency to vapor lock, thereby throwing the system operated out of balance. In the older systems of operation, the operators quite often attempted to alleviate the situation by spraying water on the fluid end of the pump. Under these conditions, several minutes elapse before normal operation can be resumed.

In one of the pump rooms of a gasoline plant in Southern California, when new equipment was installed which provided for handling raw natural gasoline, a simple device was attached to the discharge of the pump which immediately remedies vapor-lock when it occurs. Suction is taken from a large vertical tank, maintained at a predetermined level by admitting gasoline from the storage tanks through a liquid level controller; sufficient head is maintained upon this tank to provide a slight pressure on the suction of the pump. The discharge line leading to the fractionating equipment was constructed from 1½-inch pipe, and provided with 1½-inch lubricated plug valve. Below this valve, a one-inch line was welded in, leading back to the tank from which suction is taken by the pump when in operation, and a one-inch lubricated plug cock was also inserted in this return line for instantaneous control. Handles were fitted permanently to these plug cocks for the convenience of the operators.

Under normal running operation, the 1½-inch cock is opened, providing for circulation of the gasoline being handled, but if the gasoline should be so wild that vapor lock is common, or if suction should be lost for any other reason, the operator merely opens the one-inch cock, relieving the pump of high pressure discharge and returning the load to the tank. The danger of back-fire or the return of gasoline from the fractionator has been provided for by the installation of 1½-inch swing check inserted in the discharge line.

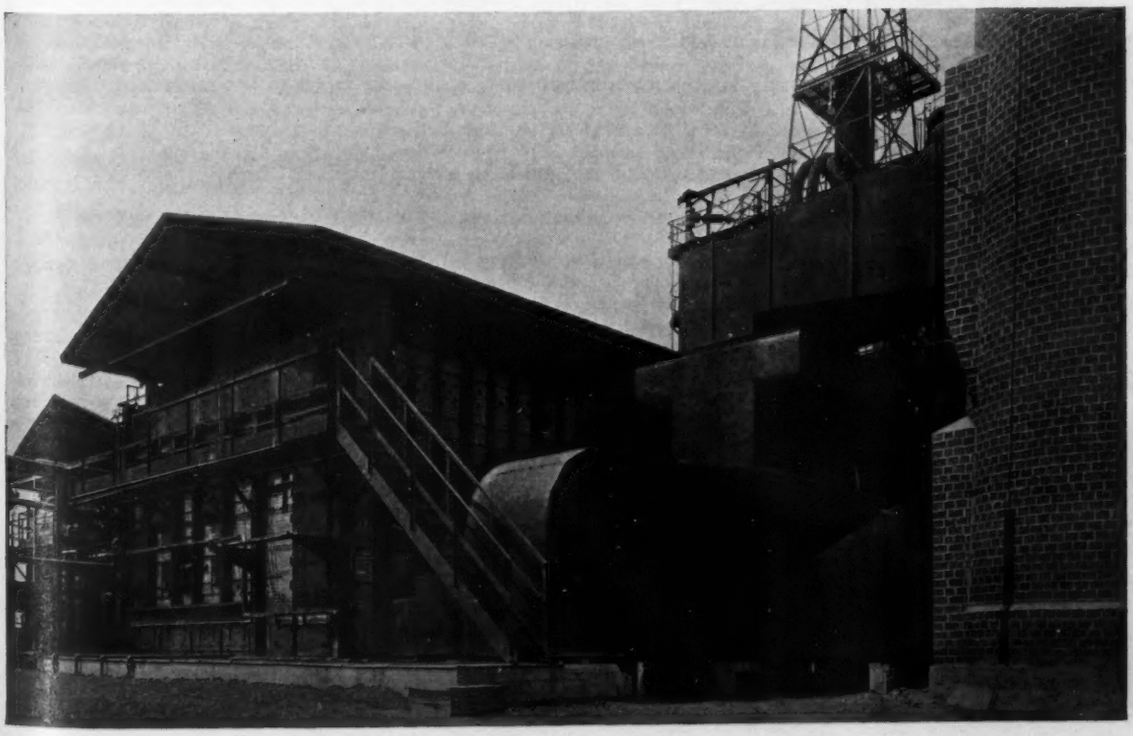
Seldom does it require over a few seconds to provide for relief of vapor lock, when it occurs, by simply opening the one-inch line, and when the pump has picked up a load of liquid, the line is closed and the pump proceeds with the normal transfer of liquid to the fractionator column.



TUBULAR HEATERS

Direct fired tubular oil heaters are furnished by Foster Wheeler for all classes of refinery service—cracking, topping, skimming, rerunning, and straight distillation. The two heaters shown were designed and constructed especially to meet the requirements of the 5,500 barrel per day Dubbs combination topping and cracking unit which they serve.

FOSTER WHEELER CORPORATION, 165 Broadway, New York.



FOSTER WHEELER

SCIENCE AND TECHNOLOGY

Abstracts prepared in co-operation with the

REFINER AND NATURAL GASOLINE MANUFACTURER

by

THE LESLIE LABORATORIES

Traver Road, Ann Arbor, Mich.

under the supervision of

DR. E. H. LESLIE and DR. H. B. COATS

The abstracts here presented are selected from the current literature of science and technology to afford reference to fundamental information not easily available to all readers. Abstracts of articles appearing in readily obtainable trade journals are not included.

Photostat copies of original articles will be supplied at cost by the Leslie Laboratories. Complete or limited bibliographies covering special topics by title, by abstract, or in complete manuscript, will also be prepared and furnished at reasonable cost by the Laboratories.

Fundamental Physical Data

Densities of Hydrocarbon Mixtures. E. W. THIELE *and* W. B. KAY, *Ind. Eng. Chem.* **25** (1933) pp. 894-98.

The importance of a knowledge of densities of petroleum liquids and vapors under various conditions of temperature and pressure is noted. The paper reviews the present knowledge of the subject and indicates the best methods of condensation and those points where more data are needed. At low pressure the gas laws are satisfactory for engineering purposes. The pressures at which they cease to be satisfactory are probably somewhat lower near the saturation line. The question of density then reduces to one of molecular weight. Where the gas laws fail, the only reliable guide apart from direct experiment is the law of corresponding states. This requires a knowledge of critical temperature, pressure, and volume of the mixture in question. Limited data are available on critical temperature but almost none on critical pressure and critical volume. Study of the density of petroleum liquids is briefly reviewed and also that of changes in volume upon mixing of different hydrocarbons. A bibliography of 19 references is appended.

Thermal Data on Organic Compounds. XII. The Heats of Combustion of Nine Hydrocarbons. H. BANSE *and* GEO. S. PARKS. *Jour. Am. Chem. Soc.* **55** (1933) pp. 3223-26.

The heats of combustion of organic compounds are important in the calculation of free energies by means of the third law of thermodynamics. Most available data were determined prior to 1900 when calorimetric methods had not reached the high standard of today. Values accurate to within 0.1% are given for diisobutylene, n-octane, durene, isodurene, prehnitene, pentamethylbenzene, hexamethylbenzene, n-dodecane, and dibenzyl. The value of a $-CH_2$ group increment is 156,350 gram calories (15°C.). Heats of combustion of position isomers are the same within the limits of experimental error.

Improved Methods of Approximating Critical and Thermal Properties of Petroleum Fractions. K. M. WATSON *and* E. F. NELSON. *Ind. Chem.* **25** (1933) pp. 880-87.

Methods are presented whereby difficultly measurable properties can be predicted from the results of standard inspection, such as the A. S. T. M. distillation and the specific gravity. Two new concepts are introduced. The molal average boiling point is used in all correlations involving the boiling point of the stock. It can be estimated from the results of the A. S. T. M. distillation. Variations in physical properties with change in the chemical character of the stock are expressed by means of a characterization factor defined as the ratio of the cube root of the molal average boiling point to the specific gravity. This factor ranges from 12.5 for purely paraffinic fractions to 10.0 for highly cracked aromatic stocks. Methods are presented on this basis for approximating the molecular weight, critical temperature, critical pressure, specific heat of liquid, specific heat of vapor, heat of vaporization at atmospheric pressure, change of heat of vaporization with pressure, and change of total heat content with pressure for stocks of varying characteristics and boiling ranges. The only experimental data required are the A. S. T. M. distillation and the specific gravity.

Entropy and Free Energy Relations Among Hydrocarbons. G. S. PARKS. *Ind. Eng. Chem.* **25** (1933) pp. 887-91.

Research project No. 29 of the American Petroleum Institute is reviewed. The entropy and free energy relationship for the paraffins, olefins, benzenoids, and polymethylenes are summarized. The limitations of the application of the so-called third law of thermodynamics to the calculation of free energies are discussed. With accurate data on heats of combustion and heat capacities it becomes possible by the application of this law to calculate free energy. A few examples of the application of free energy data to hydrocarbon reactions are given and it is pointed out that by such calculation it can be predicted whether or not a given reaction is possible and, if possible, under what conditions the reaction can thus be effected.

Chemical Composition and Reactions

Chemistry of Petroleum. D. A. HOWES. *Jour. Inst. Pet. Tech.* **19** (1933) pp. 655-72.

The paper is a review of the chemistry of petroleum and its products. Subjects covered are the origin of petroleum and the composition of crude petroleums, metallic components of crude petroleums, shales and shale oils, oil field water, the preparation of pure hydrocarbons, the isolation of pure hydrocarbons, from petroleum distillate, the composition of lignitic tar, the separation of high molecular weight paraffin hydrocarbons from eicosane to triacontane, synthesis and properties of the higher paraffins, the effect of cathode rays on hydrocarbons, the chemistry of polymerization, the chemistry of cracking, sulfur compounds, oxidation of petroleum hydrocarbons, chemical composition and properties of asphalts and pitches, and other related topics.

Purification of Hydrocarbons by Crystallization from Liquid Methane. Isolation of 2-methylheptane from Petroleum. R. T. LESLIE. *Bur. Standards J. Research* **10** (*Research Paper No.* 552) (1933) 609-18.

A method has been developed for purifying difficultly crystallizable hydrocarbon mixtures of low freezing point by crystallization from liquid methane. A sample of 2-methylheptane separated from petroleum, and having a purity of approximately 97%, boiled at 117.2°C., freezing point —111.3°, d_{20}^{20}, 0.6985.

Fractionation of Petroleum into its Constituent Hydrocarbons. E. W. WASHBURN. *Ind. Eng. Chem.* **25** (1933) pp. 891-4.

The methods used in separating a Mid-Continent crude petroleum into its component hydrocarbons are discussed. The oil was first roughly fractionated in a semi-commercial still. These fractions were rerun in a 15-liter still provided with a 20-plate bubbling bubble-cap

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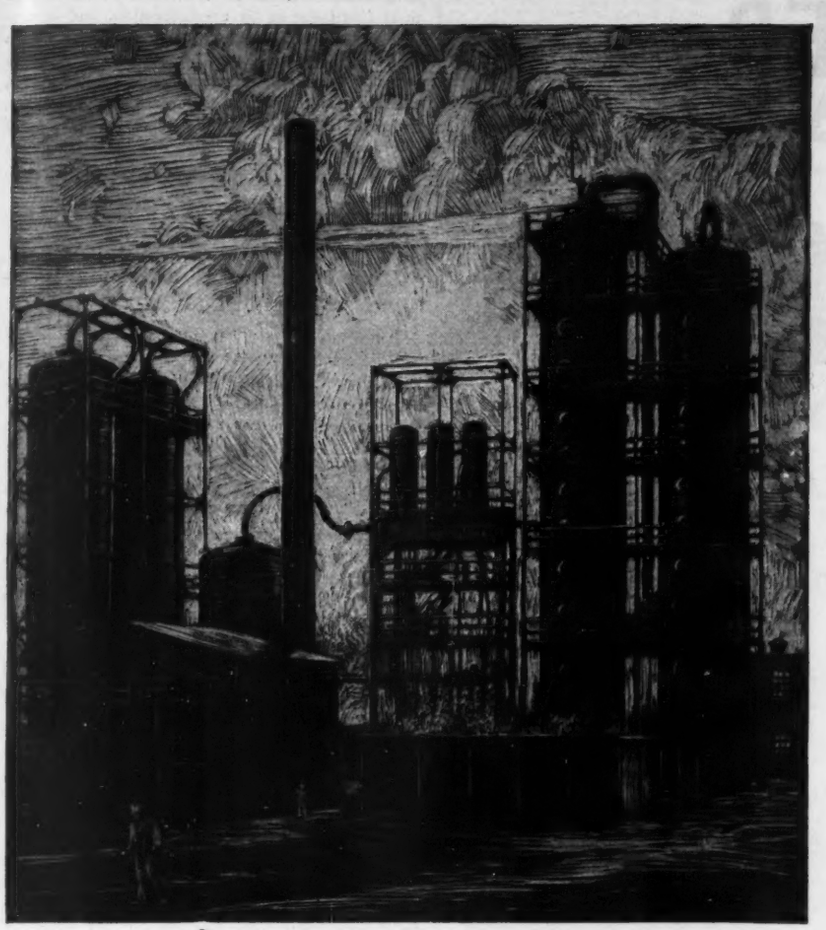

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column. When the fractions were sufficiently reduced in volume, they were handled in glass stills in the laboratory. The methods for separating constant boiling mixtures are described and, also, methods of fractionation by extraction, fractionation by crystallization, and separations by chemical means. Products of very high degree of purity have been obtained. Those secured from this particular oil are listed. A bibliography of thirty references is appended, in which references details of various phases of the work have been published.

Manufacture: Processes and Plant

The Design of Fractionating Column for Complex Mixtures. A. J. V. UNDERWOOD. *Chem. and Ind.* **52** (1933) pp. 223T.

In a previous paper [Trans. Inst. Chem. Eng. 10 (1932)] the author outlined a method for calculating the number of theoretical plates in a fractionating column for the separation of components that follow Raoult's law. The present paper deals with the separation of components that do not follow Raoult's law, but the relative volatilities of which do not vary greatly over a given range of concentration. The method is such as to obviate the necessity of calculating the composition of the phases on each plate. The formulation is developed and applied to specific problems.

Mean Temperature Difference and Heat Transfer Coefficient in Liquid Heat Exchangers. A. P. COLBURN. *Ind. Eng. Chem.* **25** (1933) pp. 873-6.

The rate of heat flow between two fluids in a heat exchanger has ordinarily been expressed as the product of the area, the temperature difference of the two fluids, and the coefficient of heat transfer. If the coefficient of heat transfer is assumed to be constant throughout the apparatus, the logarithmic mean of temperature difference at the two ends of the apparatus is the correct average temperature difference. However, it has now been shown that the coefficient of heat transfer varies with temperature and thus with the lengths of the exchangers. Therefore, the logarithmic mean of the terminal temperature differences is not the correct average value. For the special case where the overall coefficient of heat transfer is a linear function of temperature, the simple relationship has been derived that the heat transfer rate is equal to the logarithmic mean of $U_1 \Delta t_2$ and $U_2 \Delta t_1$. The subscript indicates terminal conditions. The method is a new departure in the design of heat transfer apparatus in that it uses a logarithmic mean of a combined function of heat transfer coefficient and temperature difference rather than a logarithmic mean of temperature difference and some assumed function of the heat transfer coefficient. Another procedure is developed in which the logarithmic mean of the terminal temperature differences is used in conjunction with a particular value of the heat transfer coefficient, so chosen as to give a result the same as that secured by the above method. The equations used are developed and applied to specific problems.

Lubricating Oils in Contact with Clays. V. A. KALICHEVSKY *and* J. W. RAMSAY. *Ind. Eng. Chem.* **25** (1933) pp. 941-3.

A simple laboratory apparatus has been developed and used for investigating the effects of time and temperature in decolorizing oils with clays. The time factor was found to be important and cannot be neglected in evaluating clay efficiencies. The color of the oil ordinarily improves with increased time but, owing to complicated concurrent reactions, a reversion

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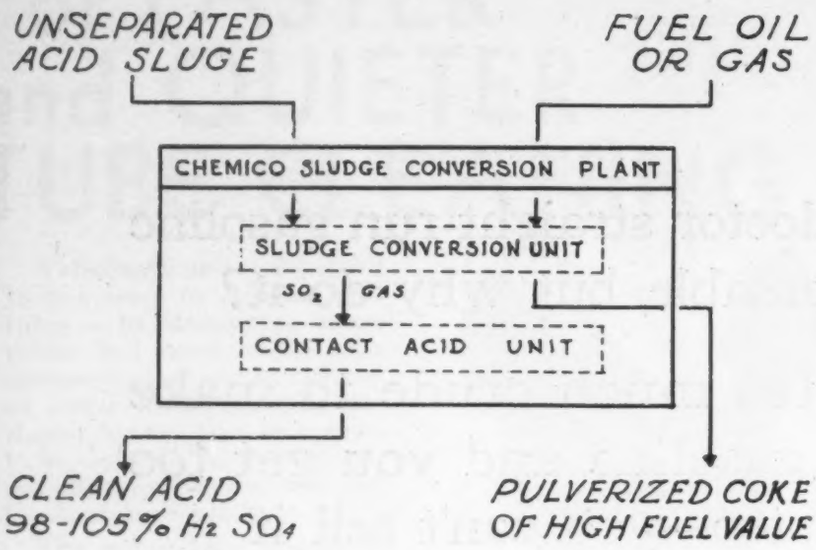

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of color may occur. The authors are inclined to believe that Freundlich's adsorption isotherm may not hold strictly for petroleum oils, although there is often good agreement. The oil treated was Mid-Continent filtered stock and was first treated with one pound of 98% sulfuric acid per gallon of oil. Colors were measured by means of the photoelectric colorimeter and color intensity scale. Temperatures were in the range of 500-750°F. Two types of activated clays and one natural clay were used.

Products: Properties and Utilization

Motor Spirits and Light Distillates. D. A. HOWES. *Jour. Inst. Pet. Tech.* 19 (1933) pp. 557-66.

Although suitable Diesel engines for automotive purposes are becoming available in increasing degree, gasoline is still the main product of the petroleum industry and is likely to remain so for a long time. In England, however, the high-speed Diesel engine is developing rapidly and this will soon have an effect upon gasoline sales. Another feature of interest is the development of alcohol-gasoline blends in Europe where several countries have imposed legislation compelling the use of alcohol in motor fuels. Compressed coal gas is making headway in France and, to some extent, in England. High gasoline taxes have given the impetus to this development. The properties of gasoline marketed in the United States and in Great Britain are reviewed, as well as the current literature on the anti-knock values of gasoline and individual hydrocarbons. Patents on anti-knock materials and on various motor fuel compositions are reviewed. The development of high flash, high anti-knock aviation fuels is noted. Other subjects discussed are vapor lock, gum formation in gasolines and its prevention, and the dyeing of gasoline.

Alcohol Motor Fuels. C. O. OSTWALD. *Automobiltech. Z* **36** (1933) 129-32, 157-8.

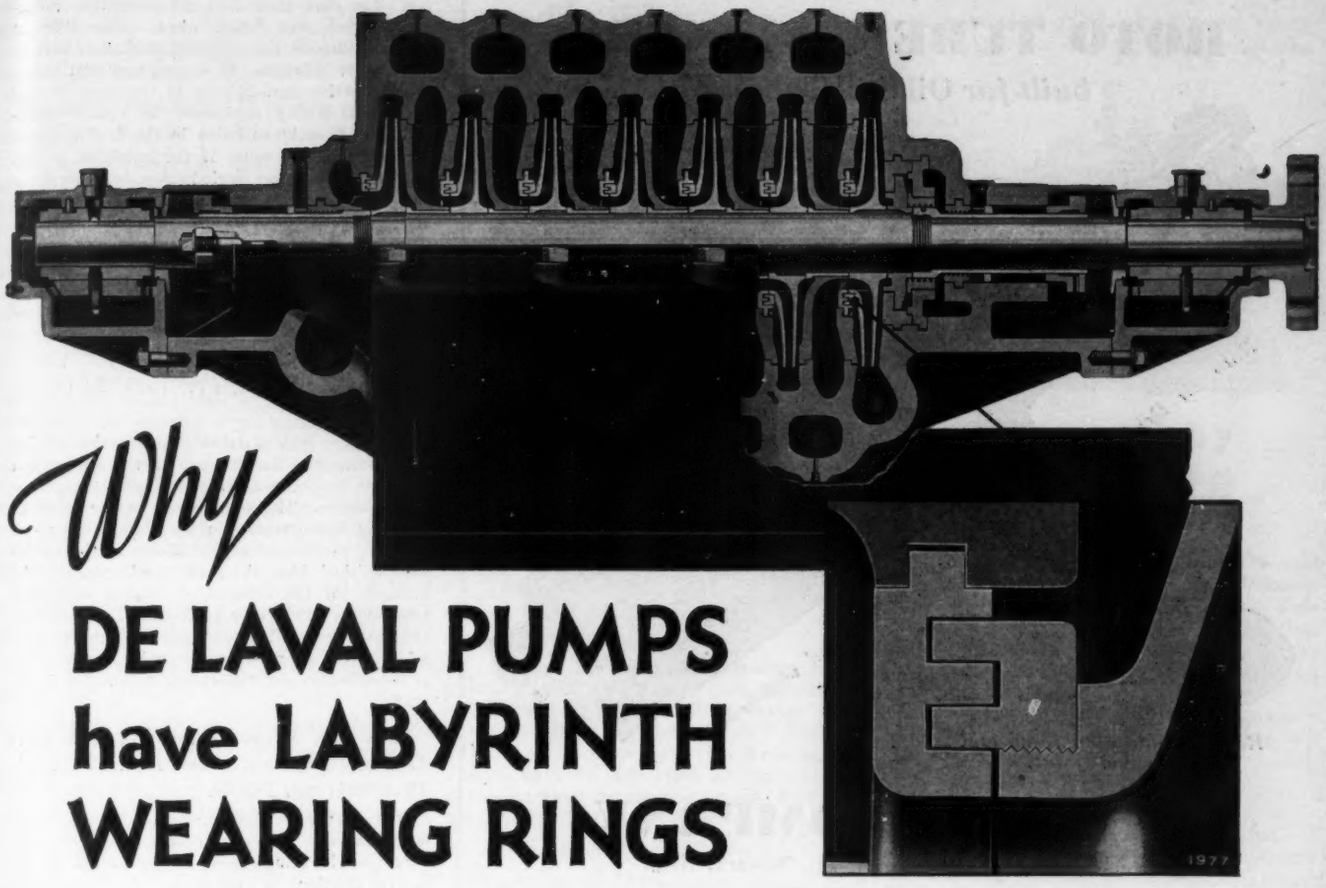
The anti-knock property and low freezing point of alcohol make it especially advantageous as an airplane fuel. Tables are given showing the relationship between alcohol content and water tolerance of the solution, the influence of chemical natures of the gasoline-alcohol mixture as regards water tolerance, and the influence of temperature on the water tolerance of an 80%-20% fuel. The high latent heat of vaporization increases power and reduces the temperature of the cylinder walls and the exhaust gas. Alcohol does not cause corrosion nor greater wear of pistons and cylinders, as has been claimed.

Gasoline Engines and Knock Testing. R. STANSFIELD. *Jour. Inst. Pet. Tech.* 19 (1933) pp. 567-73.

The author reviews trends in engine designs, engine mountings, self-starting carburetors, cylinder liners, height of valves, pressure ratios, cooling systems, ignition systems, piston designs, oil filters and coolers, and related topics. The subject of knock-testing is then discussed and the C.F.R. method reviewed. The results of the correlation of this laboratory test method with road tests under different conditions is discussed. Laboratory ratings for anti-knock values of aviation gasoline are regarded as being in a chaotic state.

Gum Stability of Gasolines. II. J. W. RAMSAY *and* H. S. DAVIS. *Ind. Eng. Chem.* **25** (1933) pp. 934-6.

The rate of rise in temperatures of gasoline during the heating-up period in oxygen bomb tests has been measured for bombs of several types, heated in an oil bath and in a water



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bath. Methods are given for correcting for this lag. The data show that the same true induction period was found when using different bombs, although the apparent induction periods were quite different. It is proposed that either true induction periods only be recorded, or that the bomb testing equipment be rigidly standardized. A slight variation in the final temperature changes the value of the induction period. The true induction period may be defined as the time elapsing between placing the bomb in the test bath and the first perceptible drop in pressure, if the gasoline sample were brought to the test bath temperature instantaneously. The importance of knowing the lag in the heating and cooling periods, and the exact value of the final temperature, is emphasized.

Kerosene and White Spirit. S. T. MICHIN. *Jour. Inst. Pet. Tech.* **19** (1933) pp. 574-77.

The paper reviews recent work on the refining of kerosene and burning oils on the composition of these products as it effects their properties in utilization. The controversy on the effect of aromatic hydrocarbons in paraffins is discussed, as well as the subject of flame brightness as distinguished from the gross candle-power. The methods for the removal of sulphur and other components are briefly reviewed. Little of outstanding interest has been noted in the field of white spirits or naphthas for paint and varnish. A bibliography of twenty-two references is included.

Gas Oil, Diesel Fuel Oil, and Fuel Oil. F. H. GARNER. *Jour. Inst. Pet. Tech.* **19** (1933) pp. 592-99.

The author reviews current knowledge and work on the fuel oils, noting that increasing attention is being given to utilization of the heavy fractions of petroleum and particularly to the employment of such products as fuel in compression-ignition engines. During the past year much attention has been given to the rating of Diesel fuels as regards their ignition qualities. Gas oils for use as absorption oils are discussed; also, for use in the carbureting of water gas. Current works on Diesel engine fuels are discussed in some detail. Work on heavy fuels is reviewed more briefly. A bibliography of 39 references is given.

The Relative Lubricating Values of Automotive Oils. HOWARD H. LANGDON. *State Col. of Wash., Engr. Expt. Sta., Bull.* 41, (1933) 15 pp.

Viscosity measurements do not necessarily show the lubricating value of an oil. Paraffin-base oils ordinarily maintain a more uniform viscosity with use than do asphalt-base oils. There is no relationship between the value of a lubricating oil and distillation tests or flash and fire tests. Cloud and pour points may be important in choosing oils for cold weather use, but have nothing to do with lubricating value for normal operation. An oil having a high carbon residues not necessarily an inferior lubricant. In automobile, laboratory, and field operation of automotive engines used in these tests, an average of 54% greater wear of the working parts took place when using typical asphalt-base oils than when using typical paraffin-base oils and leakage and pumping losses were greater by as much as 6%.

Lubricants and Lubrication. A. R. BOWEN. *Jour. Inst. Pet. Tech.* **19** (1933) pp. 578-91.

The paper is a review of current work on lubricating oils and lubrication, including distillation, treatments, color removal, dewaxing, bleaching, synthetic lubricants, pour point lowerers, theory of lubrication, adhesion of lubricants to metals, capillary flow under high pressures, lubricating oil testing machines, film lubrication

of journal bearings, bearing loads, lubrication of Diesel engines and compressors, extreme pressure lubricants, compounded lubricants, lubricating oil reclaiming, and numerous related subjects. A bibliography of 72 references is given.

Effect of Paraflow. H. SUIDA *and* H. POLL. *Petr. Zeit.* **29** (1933) 7, 6, 33.

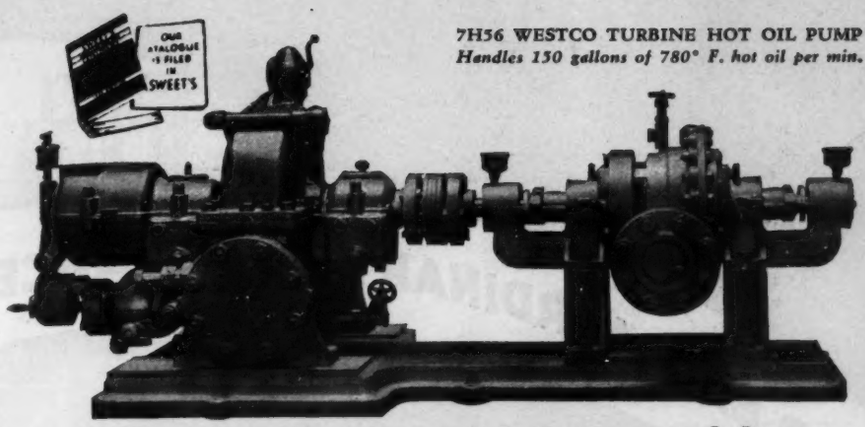
Paraflow decreases the pour point, but its effect varies from oil to oil; 0.2 to 0.3% of paraflow lowered the set point of dewaxed paraffin-base lubricating oil 7 to 8°C. and had the same effect on mixed-base oils. With viscous oils of these types, no effect was observed. Asphalt-base oils can be classified into those containing a small percentage of soft paraffin and those containing a small percentage of soft and hard paraffin and ceresin. 0.5 to 1% paraflow gave good results with the first class. Added to the second class it gave a low pour point but it did not remove the turbidity noticed at room temperatures. Lubricating oils from an asphalt-base crude are not affected by paraflow. Paraflow cannot be applied to transformer or turbine oils since they age readily after this material has been added. Conradson carbon residues are somewhat higher for oils treated with paraflow.

Effect of Graphite on Lubricating Properties of Oils. M. A. BOUTARIC *and* M. R. AMIOT. *Ann des Comb. Liq.* **8** (1933) 129-31.

Measurements of viscosity and surface tension of vaseline oil and castor oil, alone and containing small quantities of "oil-dag" and "Castordag," respectively, were made. These properties were only slightly affected by the colloidal graphite, the viscosity at 26°C. being increased approximately 1% and the surface tension reduced by the same amount. Measurements of interfacial tension, oil to mercury, showed that the graphite enhanced the adhesion qualities of both oils, more particularly that of the vaseline oil. It appears that this may be of some importance in lubrication.

Lubricating Greases. H. S. GARLICK. *Chem. Trade J.* **92** (1933) 236, 258.

The requirements of satisfactory grease are ability to flow under pressure with a minimum of "drag" through the tubes of the lubricating system, freedom from separation of oil under sustained pressure, absence of "tracking" which allows a moving part to cut a permanent channel through the grease, and ability to remain at the temperature of the bearing without marked loss of consistency or decomposition. Special lubricant gives far better service, showing decreased consumption, easier starting of the cold mill, longer life for bearings, and increased life of lubricant, than the asphaltic bitumens that have been used to an increasing extent as hot-neck lubricants in rolling mill practice. Much work has been done on the development of improved lubricants for the textile spinning industry. Completely saponifiable greases are required. Grease lubrication is still rare in British locomotive practice, although extensively used in the United States. Little development of grease lubrication has taken place in the marine service. The lubrication of rocker arms on motorcycle and aero engines has resulted in considerable research. A soft grease is required for aero engines in order to avoid damage to roller bearings and it must be efficient over a temperature range of 0°F. to 350°F. and show no tendency to gum or carbonize. It must be water resistant and able to withstand the continuous pounding of the push rods without breaking. Aluminum greases provide the best solution to date. They have the peculiar property of increasing in consistency between 100°F. and 250°F. In particular, they resist the tendency to flow away except at temperatures above 300°F.



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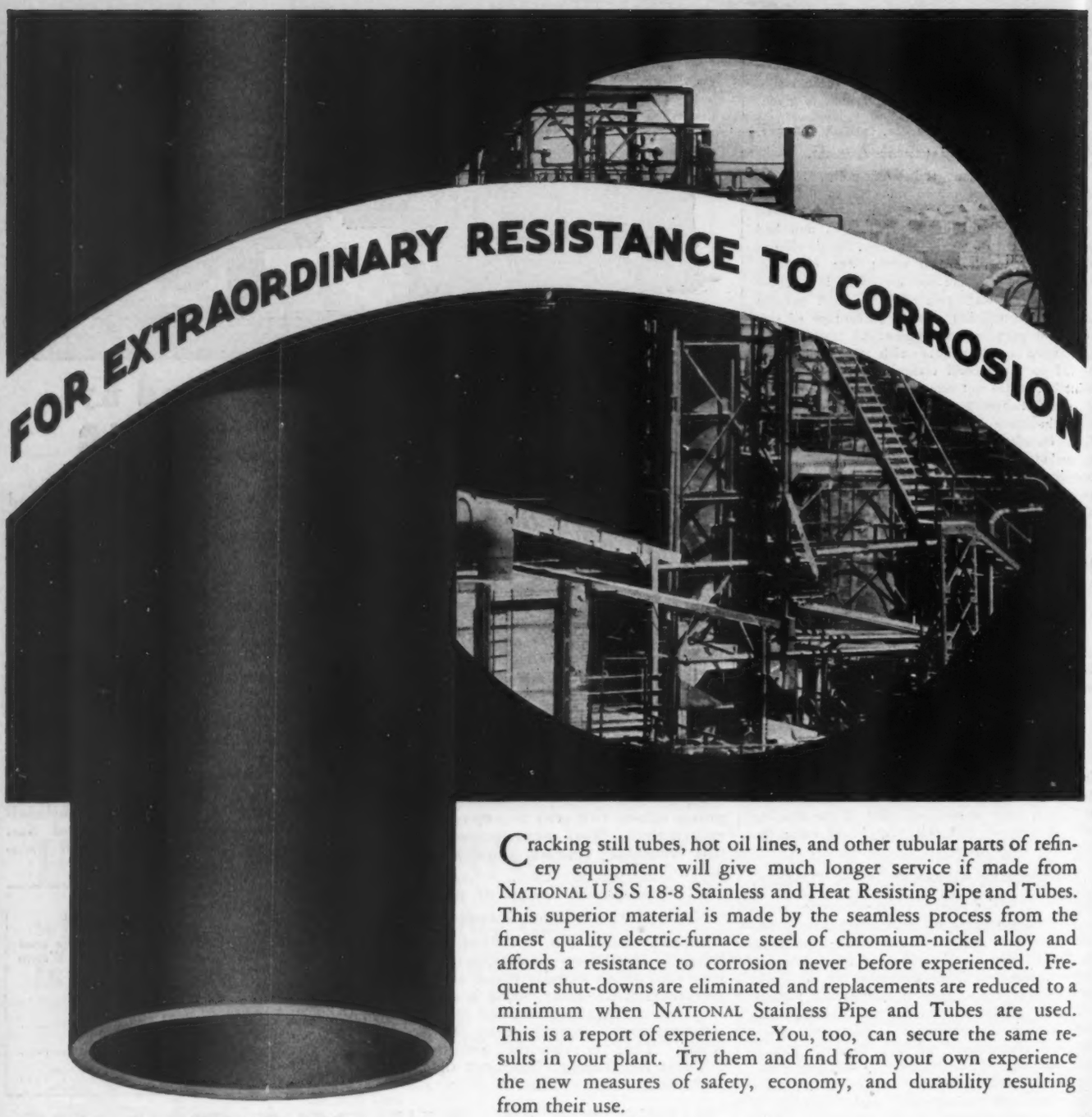

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THE MONTH IN REVIEW

NRA Wins Federal Court Attack

THE legality of the administrator of the petroleum code to require refiners to provide information as to crude oil purchased and refined products shipped was upheld in federal district court at Tyler, Texas, October 3, when Judge Randolph Bryant denied the injunction sought by Panama Refining Company. Relief was asked in a suit against J. Howard Marshall, assistant United States Attorney General, A. D. Ryan, special investigator of the Department of the Interior, and S. D. Bennett, United States District Attorney at Beaumont.

The court ruled to the effect that congress had plenary powers of over interstate commerce and that led to the presumption that the act under which the information is sought is constitutional. In some respects the ruling was similar to that previously given in the supreme court of the District of Columbia, when 48 East Texas refiners sought to overthrow the activities of federal authorities in the East Texas oil field on the grounds that the National Industrial Recovery Act is unconstitutional.

Although the National Industrial Recovery Act was not involved as a whole, authorities in Washington hailed the decision as one more indication that the statute will finally have court approval. Harold L. Ickes said he considered the victory one in favor of the whole petroleum code.

CHARLES L. SUHR, The Pennzoil Company, Oil City, Pennsylvania, was elected president of the National Petroleum Association at the annual meeting in Atlantic City, September 20, 21 and 22. He succeeded E. M. Lyons, Tiona Refining Company, who held the position six years. N. H. Weber, The Pure Oil Company, was elected first vice president and H. A. Logan, United Refining Company, second vice president. G. B. Hunter was re-elected treasurer and Fayette B. Dow retained as general counsel.

Three new trustees were elected: R. G. van der Woude, Shell Petroleum Corporation; Paul G. Blazer, Tri-State Refining Company; and H. L. Lewis, Conewango Refining Company. Trustees re-elected are John A. Beck, Pennsylvania Refining Company; H. M. Carruth, Canfield Oil Company; Sheldon Clark, Sinclair Refining Company; Earle M. Craig, Freedom Oil Works Company; Frank B. Fretter, National Refining Company; W. V. Hartman, Gulf Refining Company; W. T. Holliday, Standard Oil Company of Ohio; O. P. Keeney, Wolverine Empire Refining Company; Otto Koch, Kendall Refining Company; C. J. Leroux, Valvoline Oil Company; H. A. Logan, United Refining Company; E. M. Lyons, Tiona Refining Company; A. W. Scott, Wolverine Empire Refining Company; C. G. Sheffield, Standard Oil Company of New Jersey; Charles L. Suhr, the Pennzoil Company; N. H. Weber, The Pure Oil Company; A. C. Woodman, Richfield Oil Company of New York; and R. A. Wotowitch, Crew-Levick Company.

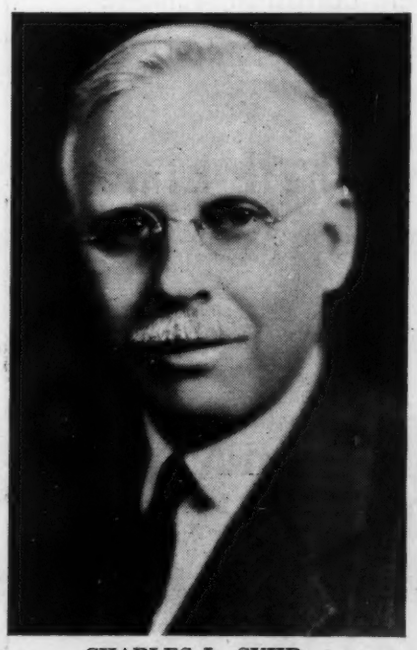
Regulations Issued for Federal Reports on Oil

REGULATIONS covering the reports to be submitted by members of the oil industry under the provision of Section 6, Article VII, of the oil code, approved by Secretary of the Interior Harold L. Ickes September 29, will require the submission of weekly and monthly reports and stocks and purchases of crude oil and refinery operations and gasoline stocks and pipe line activities.

Holders of crude oil are required to report stocks monthly by the 15th of each month, but holders of stocks of 100,000 barrels or more are to report weekly.

Refineries are to make monthly reports of crude receipts and a balanced statement of supply and demand, and statements of refinery operations. Monthly reports of gasoline stored at bulk terminal plants are to be made, and pipe lines are to report on gasoline receipts, deliveries and stocks:

The regulations governing the rendition of these reports are as follows:



CHARLES L. SUHR

Pursuant to Section 10 (a) of the National Industrial Recovery Act (Public No. 67, 73d Congress) and Article VII, Section 6 of the Code of Fair Competition for the Petroleum Industry, as approved by the President on August 19, 1933, and as amended and approved by the President on September 19, 1933, and in accordance with the Executive order of August 28, 1933, I hereby require that the following information be furnished the Department of the Interior, as the Federal Agency designated by the President under the aforesaid Code of Fair Competition:

1. **Crude Petroleum Stocks Report:** All persons, natural or artificial, holding crude petroleum in storage, shall complete and return to the United States Bureau of Mines, Washington, D. C., not later than the fifteenth day of each and every calendar month a report of total crude inventory on hand the last day of each calendar month, including net stocks of crude petroleum held in the custody of the reporting natural or artificial person, regardless of ownership, as well as all domestic crude petroleum in transit by water or tank cars, as prescribed on form No. A-947 of the Petroleum Administrative Board of the Department of the Interior. All such persons doing business east of California holding crude petroleum stocks of 100,000 barrels or more shall report weekly the total stocks indicated by (*) on the aforesaid form A-947, which information shall be forwarded by telegraph or transmitted by air mail, special delivery letter, or otherwise, so as to be received by the United States Bureau of Mines, Washington, D. C., not later than 9 o'clock each Tuesday morning. All such persons doing business in California and holding crude petroleum stocks of 100,000 barrels or more shall report weekly the aforesaid stocks, which information shall be forwarded by telegraph or transmitted by air mail, special delivery letter, or otherwise, so as to be received by the office of the United States Bureau of Mines, Custom House Building, San Francisco, California, by 9 o'clock on each Tuesday morning.

2. **Crude Petroleum Report by Refineries:** All refineries shall complete and return to the United States Bureau of Mines, Washington, D. C., within fifteen days after the close of each and every calendar month a report of crude petroleum received at each and every refinery owned, operated, or controlled by the reporting company, together with a balanced statement of supply and demand, as prescribed on form A-943 of the Petroleum Administrative Board of the Department of the Interior.

3. **Monthly Crude Petroleum Report:** All persons, natural or artificial, in any manner operating or controlling pipe lines for the transportation of crude petroleum, and all other persons, natural or artificial, holding stocks of crude petroleum on leases or tank farms shall complete and return to the United States Bureau of Mines, Washington, D. C., within 25 days after the close of each and every calendar month, a monthly crude petroleum report, as prescribed by forms No. 947 and 947-a of the United States Bureau of Mines.

4. **Monthly Refinery Report:** All persons, natural or artificial, in any manner owning, operating or controlling petroleum refineries shall complete and return within 25 days after the close of each calendar month, a report of refinery operations as prescribed on form No. 943 of the United States Bureau of Mines. Crude oil refined for the account of other companies must be included in this report but with special notation to this effect.

5. **Gasoline Storage at Bulk Terminals:** All

persons, natural or artificial, owning, controlling, or otherwise holding gasoline in storage at bulk terminal plants shall complete and return to the United States Bureau of Mines, within 15 days after the close of each any every calendar month, a report of gasoline so stored as prescribed on form No. 943-c of the United States Bureau of Mines.

6. Transportation of Gasoline by Pipe Lines, Including Gasoline Stocks Held in Storage or Transit: All persons, natural or artificial, in any manner owning, controlling, or operating pipe lines for the transportation of gasoline shall prepare and return to the United States Bureau of Mines, Washington, D. C., within 15 days after the close of each and every calendar month a complete report of all gasoline receipts, deliveries, and stocks, as prescribed by form No. 943-d of the United States Bureau of Mines.

▼ PLANT ACTIVITIES ▼

Capacity Increased: O. C. Field Gasoline Company has enlarged and worked over its Huntington Beach absorption plant, capacity having been increased to 31,000,000 cubic feet from around 10,000,000 cubic feet. This company has been handling a large part of the gas produced by new producers in the Huntington Beach field.

Construction: Union Oil Company is planning construction of a large Edeleanu plant at its Oleum refinery, near San Francisco. Bids for furnishing various supplementary equipment are now being considered.

The Texas Company is completing a 15,000,000 cubic foot absorption plant in the Huntington Beach, California, field.

Rerun Unit: Mitsubishi Refining Company, operating one of the largest refineries in Japan, recently installed a 4000-barrel pressure distillate rerun unit. C. F. Braun and Company supplied the equipment.

Capacity Enlarged: Standard Oil Company of California has increased the capacity of its Huntington Beach absorption plant to more than 11,000,000 cubic feet from around 8,000,000 cubic feet. The additions included a full line of new equipment.

Improvements: Barnsdall Oil Company has completed a modernization program at its Elwood, California, absorption plant. The improvements included changes in the stabilizer equipment, water softening machinery, and additions to safety devices. Corrosion of instruments, due to action of the salt air, was checked through encasement in tight wooden boxes which were provided with small windows and doors.

Gasoline Plant: Gregg-Tex Gasoline Corporation, Longview, Texas, is scheduled to start operating early in October a large natural gasoline manufacturing plant in the Longview section of the East Texas field. The plant is located on Humble Oil & Refining Company's W. R. Hughes lease, D. Sanches survey, Gregg County, and the output is to be sold by the Brooks-Hanlon Gasoline Company, Tulsa.

Building: Hercules Gasoline Company, Inc., Shreveport, Louisiana, is erecting a natural gasoline manufacturing plant in the Kilgore section of the East Texas field. The plant is situated on the Gulf Production Company's A. Spear lease. The company has designated L. J. Dales, Kilgore, as its agent in Texas.

Operating: New Deal Oil & Refining Company, Abilene, Texas, resumed operating late in September the 240-barrel daily capacity crude skimming plant formerly identified as the Abilene Refining Company at Abilene. R. O. Anderson is manager, and Claude Comegys is plant superintendent. The plant procures its crude supply via tank trucks from the Noodle Creek field, Jones County.

Fire: Taxman Refining Company's skimming and cracking plant on the edge of Wichita Falls, Texas, experienced an explosion and fire on the morning of September 28 that cost the lives of four workmen. The victims included: Bob Finley, Clyde Holland, Fred Arbuckle and Ralph Spettel. The plant was badly damaged by the fire that followed in the wake of the explosion. It had just resumed operations after a brief shutdown for minor repairs.

Purchase: The Owl Refining Company, Kilgore, Texas, has been formed by John W. Hooser, Wm. J. Gerron et al to take over and operate the Shore Line Refining Company's 750-barrel daily capacity skimming plant situ-

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ated in the Kilgore section of the East Texas oil field.

Power Plant: An additional boiler, 500 horsepower, is being added to the equipment of Globe Oil & Refining Company, McPherson, Kansas. The gasoline recovery plant has been provided with an additional compressor. Storage facilities, also are being enlarged.

Tank Farm: Pan American Refining Corporation has purchased the storage terminal of Magnolia Petroleum Company at Texas City, where the new refining plant of Pan American is under construction. Recently the new lines of Stanolind Pipe Line Company were completed to the Texas City site. Pan American is a subsidiary of the Standard Oil Company (Indiana.)

Plant Completed: Shamrock Oil & Gas Company has completed a small skimming plant at Lefors, Texas. Crude will be taken from Gray County fields, as the lines of the Bell Oil & Gas Company extending into this area has been purchased by the Shamrock Company.

Refinery: Lobitos Oilfields, Ltd., Ellsmere Port, Manchester Ship Channel, England, building a new refinery, contract to Alco Products, Inc.

Solvent Process: Vacuum Oil Company, Paulsboro, New Jersey, refinery will soon start installation of a Duo-Sol system of solvent refining. Max B. Miller Company, contract, and The Lummus Company, construction engineers.

Solvent Process: Magnolia Petroleum Company, Beaumont, Texas, is erecting an installation of the Duo-Sol refining process marketed by Max B. Miller Company, The Lummus Company, construction engineers.

Dixie Oil & Refining Company started operation of its 1500-barrel skimming plant September 23 at Jackson, Mississippi. It is the only refinery in the state. Raw material is being shipped from East Texas. Ed Condon is president, Charles Wright, is general manager and W. F. Mitchell is superintendent.

Sinclair Refining Company is building a canning plant at the refinery on the Houston ship channel. It will be used for packaging lubricating oil for southern, southeastern and part of the Sinclair territory in the Middle West.

Defendants Win Texas Anti-Trust Suit

First blood in the effort to oust 15 major oil companies from Texas went to the defendants October 5, when Judge J. D. Moore upheld their general demurrer in the Ninety-eighth District Court. His decision was based on the opinion that the National Industrial Recovery Act and the codes approved by the President thereunder have superseded the anti-trust laws of Texas.

Notice of appeal was given by James V. Allred, attorney general, who instituted the litigation November 12, 1931. He sought to cancel charters, permits to do business and to oust the 15 oil companies and two trade associations from the state on the charge that the anti-trust laws of Texas had been violated when the provisions of the National Code of Practices for the Selling of Refined Petroleum Products were instituted in Texas. The code was brought into existence through the Federal Trade Commission by the American Petroleum Institute, which along with the Texas Petroleum Marketers Association gave the case 17 defendants.

The decision of the court contained this observation:

"I gather that the gentlemen representing the defendants believe in the constitutionality of the National Industrial Recovery Act. I gather that counsel for the state believe likewise and that the difference between them is on the question whether the act is not intended for intrastate business, but is confined alone to interstate business. No two men have the same vocabulary. All will differ on the meaning of words. Whatever differences of opinion there may be, I take it we are all with Congress and the President, who may be called the father of his country at this time, in their efforts to meet a great emergency. Should we find it difficult to determine exactly as to whether intrastate transactions burden interstate commerce, we might look to the human side, on account of the emergency, and on the human side remark that the father has a right to go into the homes of his children to do those things which are for the public good."

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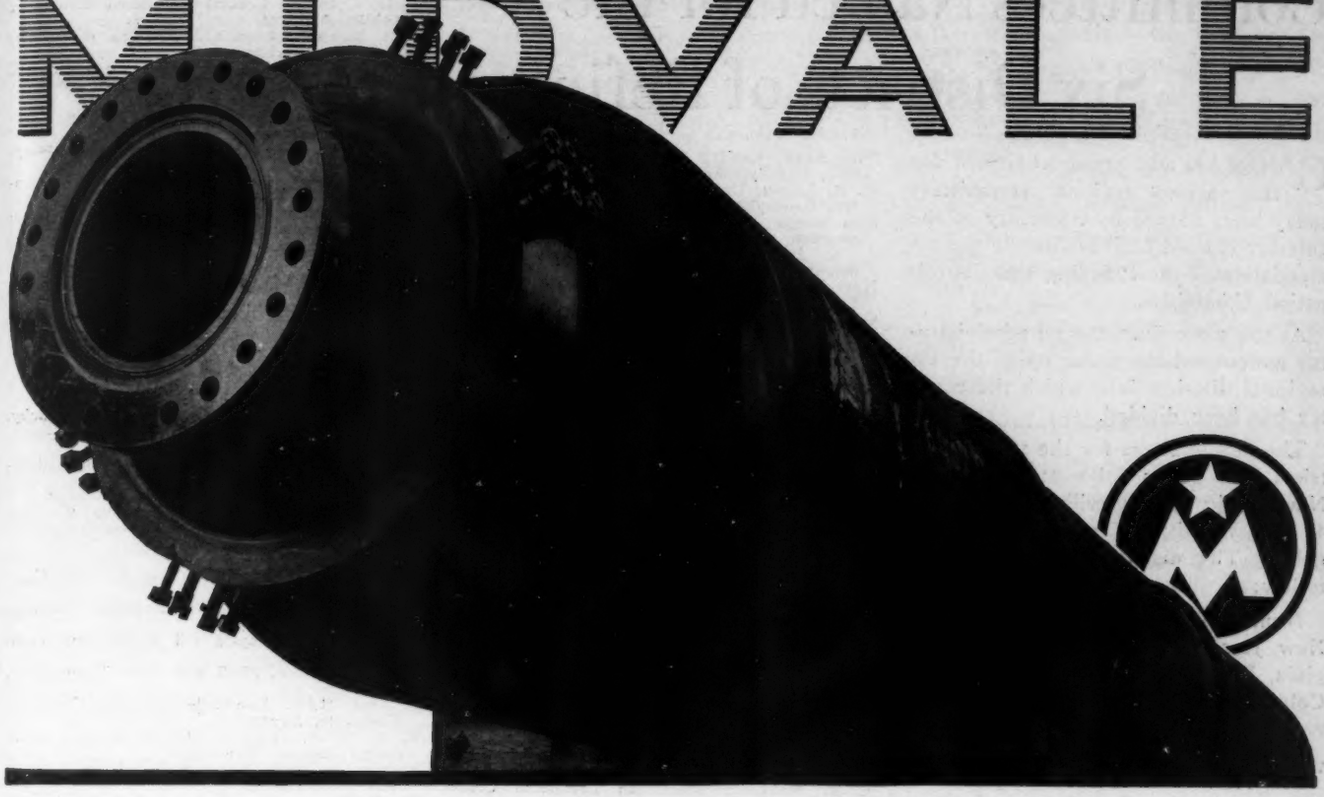

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Committees Named for the Six Districts of Refining

GENERAL and group chairmen for the various regional committees today were named by Secretary of the Interior Harold L. Ickes on the recommendation of the Planning and Coordination Committee.

At the same time, the oil administrator announced the make up of the six regional districts into which the country has been divided.

The headquarters for the several districts will be as follows: Number 1, New York; 2, Louisville; 3, Chicago; 4, Fort Worth; 5, Denver; 6, Los Angeles. The districts and committees follow:

Number 1: New England, New York, New Jersey, Pennsylvania, West Virginia, Delaware, Maryland, District of Columbia.

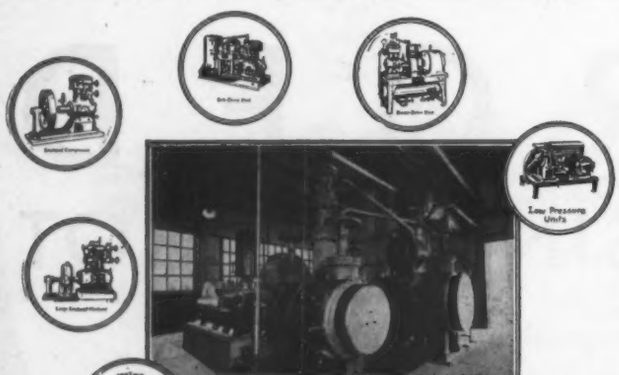
Frank R. Coates, chairman, Cities Service Oil Company, New York.
Wilbur Burt, Socony-Vacuum Corporation, New York.
Chas. B. Buerger, Gulf Refining Company, Pittsburgh.
W. M. Irish, Atlantic Refining Company, Philadelphia.
Otto Koch, Kendall Refining Company, Bradford, Pennsylvania.
H. A. Logan, United Refining Company, Warren, Pennsylvania.
Sam Messer, Quaker State Oil Refining Corporation, Oil City, Pennsylvania.
A. E. Pew, Jr., Sun Oil Company, Philadelphia.
Noel Robinson, Tide Water Associated Oil Company, New York.
C. L. Suhr, The Pennzoil Company, Oil City.
Chester Smith, Standard Oil Company (New Jersey), New York.
Geo. H. Taber, Jr., Sinclair Refining Company, New York.

Number 2: Virginia, Tennessee, North Carolina, South Carolina, Georgia, Florida, Alabama, Louisiana, Mississippi, Arkansas.

Regional District No. 2.
T. H. Barton, chairman, Lion Oil Refining Company, El Dorado, Arkansas.
Don Smith, 122 East 42nd St., New York, for Pan-American Plants located at Savannah, Georgia, and Destrehan, Louisiana.
John E. Shatford, Ouachita Valley Refining Company, El Dorado, Arkansas.
Henry H. Gross, H. H. Gross Company, Chicago.
Frank Pryor, Stanolind Oil & Gas Company, Tulsa, for Superior Oil Company, Vivian, Louisiana.
D. P. Hamilton, Root Refining Company, Shreveport. (Chairman for Arkansas.)
D. W. Harris, Louisiana Oil Refining Corporation, Shreveport.
J. K. Mahoney, Macmillan Petroleum Company, El Dorado.
B. H. Gray, Spartan Refining Company, Shreveport.
H. H. Hewetson, Standard Oil Company of Louisiana, Baton Rouge. (Chairman for Louisiana.)
A. H. Cochran, Coastal Petroleum Company, Mobile, Alabama.
J. J. Allinson, Lion Oil Refining Company, El Dorado, Arkansas.
Geo. Taber, Jr., Sinclair Refining Company, 45 Nassau St., New York, for Sinclair plant at Meraux, Louisiana.
W. B. Hassett, Kettle Creek Refining Company, El Dorado.
R. B. High, New Orleans Refining Company, Houston.
P. B. Williams, Chalmette Petroleum Corporation, New Orleans.
F. R. Schneider, Dallas, for Simms Oil Company, Smackover, Arkansas.
S. T. Manley, The Texas Company, New York.

Number 3: Ohio, Indiana, Illinois, Kentucky, Michigan, Wisconsin, Minnesota, North Dakota, South Dakota, Nebraska, Iowa, Missouri.

Regional District No. 3.
Paul G. Blazer, chairman, Ashland, Kentucky.
A. M. Maxwell, Standard Oil Company (Ohio), Cleveland.
Charles McLean, Canfield Oil Company, Cleveland.
Joe Pew, Sun Oil Company, Philadelphia.
R. C. Osterstrom, Pure Oil Company, Chicago.
M. G. Paulus, Standard Oil Company (Indiana), Chicago.
George Uzzle.
C. B. McCullough, White Star Refining Company, Detroit.
W. E. Anderson, Naph-Hol Refining Company, Muskegon, Michigan.
H. W. Camp, Empire Oil & Refining Company, Tulsa.
H. H. Anderson, Shell Petroleum Corporation, St. Louis.
J. Fred Miles, Louisville Refining Company, Louisville, Kentucky.
R. B. Tyler, Glasgow Oil & Refining Company, Glasgow, Kentucky.
Fayette B. Dow, National Petroleum Association, Washington.
W. M. Thompson, Allegheny Arrow Oil Company, Canton, Ohio.
F. B. Fretter, National Refining Company, Cleveland.



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G. H. Woodruff, Glove Oil Company, Chicago.
H. H. Cross, H. H. Cross Co., Chicago.
George H. Taber, Jr., Sinclair Refining Company, New York.
John Borden, Old Dutch Refining Company, Muskegon, Michigan.
C. L. Maguire, Roosevelt Refining Company, Mt. Pleasant, Michigan.
Henry Stolz, Wadhams Oil Company, Milwaukee.
H. T. Ashton, Lubrite Refining Corporation, St. Louis.
Wm. Stoll, Stoll Oil Refining Company, Louisville.
H. R. Abbott, Aetna Oil Service, Louisville.
F. T. Manley, The Texas Company, New York.

Number 4: Kansas, Oklahoma, Texas, New Mexico.

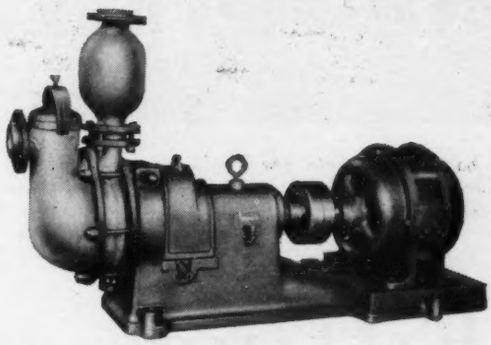
Regional District No. 4.
H. C. Wiess, chairman, Humble Oil & Refining Company, Houston.
J. A. Vickers, Vickers Petroleum Company, Wichita, Kansas.
Clyde Boggs, Kanotex Refining Company, Arkansas City, Kansas.
Francis Johle, Globe Refining Company, Wichita, Kansas.
Ted Helling, El Dorado Refining Company, El Dorado, Kansas.
Geo. H. Tabor, Sinclair Refining Company, Chicago.
Emery Marshall, White Eagle Oil Corporation, Kansas City.
Emby Kay, Skelly Oil Company, Tulsa.
Frank Holsten, Barnsdall Corporation, Tulsa.
A. L. Derby, Derby Oil Company, Wichita.
H. R. Snow, Standard Oil Company (Indiana), Neodesha, Kansas.
Frank B. Fretter, National Refining Company, Cleveland.
Clyde W. Alexander, Phillips Petroleum Company, Bartlesville.
Geo. H. Burrowes, Anderson Pritchard Oil Corporation, Oklahoma City.
R. C. Osterstrom, Pure Oil Company, Tulsa.
Walter Miller, Continental Oil Company, Ponca City.
H. W. Camp, Empire Oil & Refining Company, Tulsa.
Homer Wilcox, Wilcox Oil & Gas Company, Tulsa.
F. B. Koontz, Mid-Continent Petroleum Corporation, Tulsa.
W. B. Hagan, Paramount Refining Company, San Angelo, Texas.
Dan Danciger, Petroleum Refractionating, Longview, Texas.
C. A. Middleton, Kent-Middleton Refining Company, Corsicana, Texas.
A. R. Slemp, Pioneer Oil & Refining Company, San Antonio.
M. E. Baish, Malco Refineries, Inc., Artesia, New Mexico.
C. M. McNutt, McNutt Oil & Refining Company, El Paso.
S. E. Stretton, Pasotex Petroleum Company, El Paso.
E. R. Lederer, Texas Pacific Coal & Oil Company, Fort Worth.
Frank Smith, Oriental Refining Company, Dallas.
W. M. Harrison, Star Refining Company, Fort Worth.
L. B. McCammon, Marathon Oil Company, Tulsa.
Roy B. Jones, Panhandle Refining Company, Wichita Falls.
Dave G. Gray, Waggoner Refining Company, Wichita Falls.
E. E. Plumley, Magnolia Petroleum Company, Beaumont.
F. P. Dodge, The Texas Company, Port Arthur.
H. S. Lane, Crown Central Petroleum Corporation, Houston.
J. L. Finley, Humble Oil & Refining Company, Houston.
Ralph High, Shell Petroleum Corporation, Houston.
W. G. Slater, Gulf Refining Company, Port Arthur.
H. H. Champlin, Champlin Oil & Refining Company, Enid, Oklahoma.
W. E. Moody, Deep Rock Oil Corporation, Cushing, Oklahoma.
D. A. Corcoran, Black Gold Refining Company, Oklahoma City.

Number 5: Montana, Wyoming, Colorado, Utah.

Regional District No. 5.
T. A. Dines, chairman, Utah Oil Refining Company, Salt Lake City, Utah.
L. M. Johnson, Producers & Refiners Corporation, Parco, Wyoming.
E. C. Holt, Utah Oil Refining Company, Salt Lake City, Utah.
Dan Beard, Standard Oil Company (Indiana), Casper.
James Fenex, Continental Oil Company, Denver.
William Rice, Laurel Refining Company, Great Falls, Montana.
J. W. Glass, White Eagle Oil Corporation, Casper.
H. H. Schwartz, Arro Oil & Refining Company, Casper.
C. W. Hart, Hart Refining Company, Missoula, Montana.
Paul Stock, Bighorn Oil & Refining Company, Billings, Montana.
T. J. McIntyre, Wassatch Refining Company, Salt Lake City.
L. F. J. Wilking, The Texas Company, Casper.

Number 6: Washington, Oregon, Idaho, Nevada, California, Arizona, Alaska, Hawaii.

Regional District No. 6.
C. E. Olmstead, chairman, The Texas Company, Los Angeles.
L. F. Bayer, Associated Oil Company, San Francisco.
S. J. Dickey, General Petroleum Company, Los Angeles.
Arthur Kelly, Richfield Oil Company, Los Angeles.
A. E. Lacomble, Shell Oil Company, San Francisco.
A. S. Russell, Standard Oil Company, San Francisco.
W. L. Stewart, Jr., Union Oil Company, Los Angeles.
W. J. Reid, Hancock Oil Company, Long Beach.
R. S. McMillan, McMillan Petroleum Company, Long Beach.
J. F. Bushnell, Seaside Oil Company, Los Angeles.
L. T. Barnason, Norwalk Company, Los Angeles.
R. R. Bush, Bush Oil Company, Long Beach.
C. F. Edington, Edington Oil & Refining Company, Long Beach.
M. Drader, Sthelena Petroleum Company, Los Angeles.



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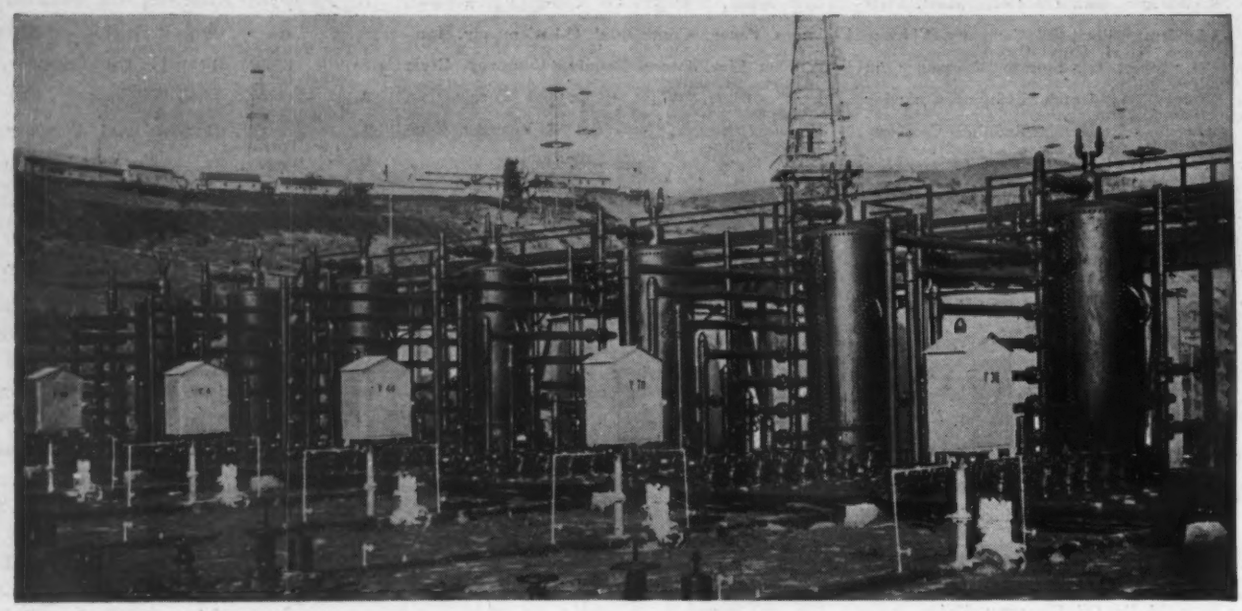


Every facility for handling oil and gas production is provided by this efficient hook-up in the Ventura Avenue Field, California. The orifice fittings insure ease in changing plates to measure the varying volumes of gas that pass from the separators.

Orifice Fittings *Aid in* Flexible Separator Hook-Ups . . .

WALLACE A. SAWDON
Petroleum Engineer, Los Angeles

ACCURACY in gas measurement has now reached a point where it is universally recognized as a necessity rather than something just to be desired. This applies to gas being produced with oil from individual wells as well as to gathering and main gas transportation systems; and is especially necessary for individual wells where gas-oil ratio regulations are in effect. Of primary importance in gas measurement, however, is the size of the orifice used for measuring the flow of the gas; and while there are many cases where a constant volume does not necessitate the changing of plates, the amount that passes through the orifice often varies to such an extent under operating conditions that frequent changing of the plate becomes necessary to secure accuracy in measurement.

The orifice fitting has done much to insure this accuracy. It is only natural, when flanges have to be broken and the gas either by-passed or shut off, to hesitate for a long time before going to the trouble of changing an orifice plate. Many a chart has, however, been sent in continuously with the differential line making a perfect circle at the outer limit. What the actual differential was could not even be guessed, much less estimated. Yet the change to a larger orifice would readily correct the difficulty. Moreover, too large an orifice has often sent in charts where the differential line hugged or, in cases where the pen was not in adjustment, even fell below the zero line.

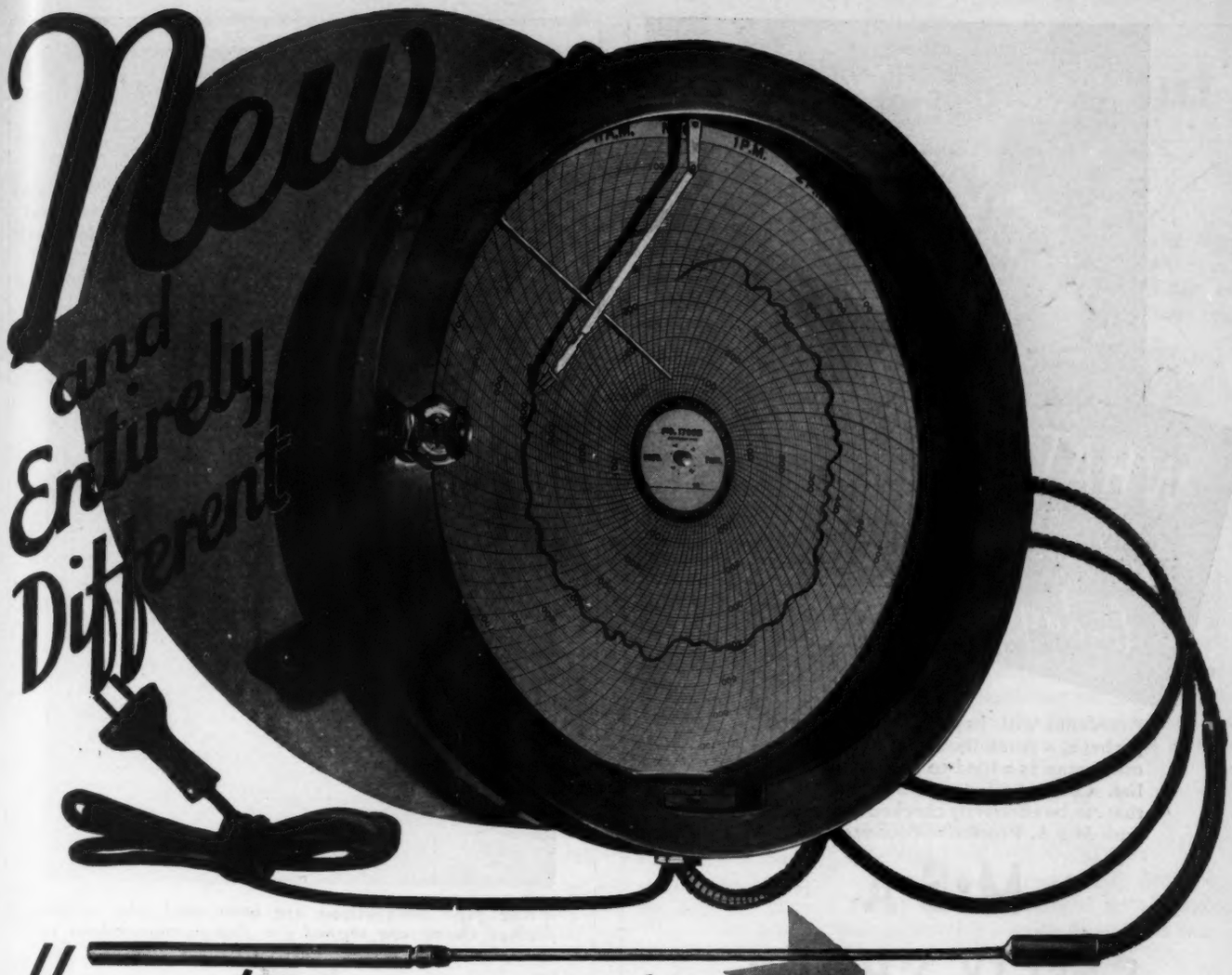
The convenience and ease in changing plates as provided by the orifice fitting has naturally eliminated the continued use of the wrong size orifice. With the installation of an orifice fitting, the differential can be kept within the range where it will give the closest reading; and the change can be done without any interruption of service or even the closing and opening of valves. Plates that remain in the line for a long time can be readily cleaned; and while this may not be necessary with some gases, there are many cases where deposits and corrosion on the plates make it desirable that they be cleaned at frequent intervals.

Batteries of separators and tanks are now being installed on many leases to provide maximum flexibility in meeting varying production conditions. The volume of gas passing out of any one separator may therefore change at any time; and this necessitates a means for quick and easy changing of the orifice plate on the gas line from the trap. The orifice fitting thus maintains the flexibility secured by the manifold connections for the incoming oil by providing the proper orifice size to measure the volume of gas discharged by the separator.

An efficient hook-up of this type is shown in the above illustration which is the most recent installation of the Associated Oil Company on its Lloyd lease in the Ventura Avenue field, California. The oil from the wells can be diverted into any tanks desired by means of the manifold system which can be seen in front of the traps. The gas, passing from the tops of the separators, enters the half-buried line and, after passing through the orifice fittings, goes on to the natural gasoline plant for treatment. The five orifice fittings shown are the Byron Jackson type.

By means of this hook-up, one or more wells can be turned into one separator, or if a large well is brought in,

New and Entirely Different



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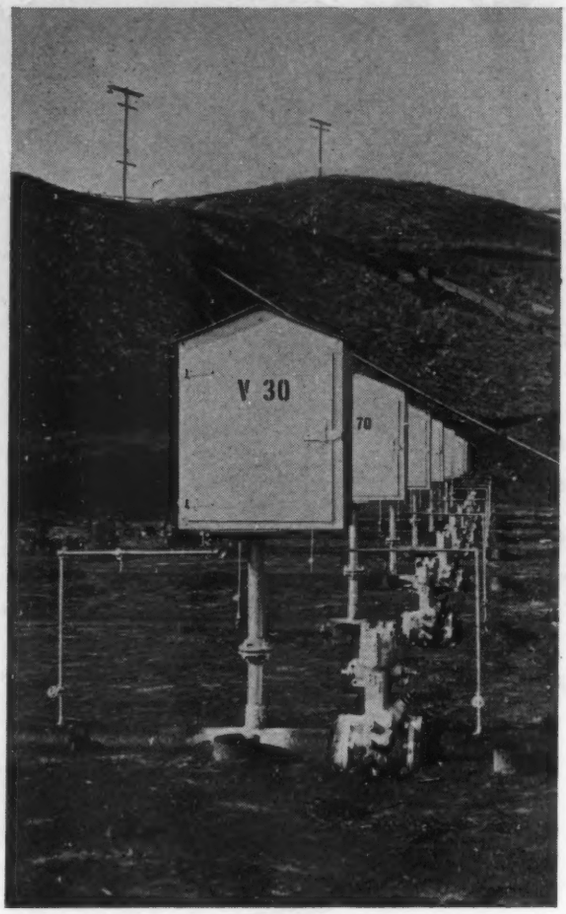


While pipe connections are here used, the orifice fittings shown are tapped for flange connections so that the meter setting desired by the operator can be used.

its production of oil and gas may go into two or three separators. This depends, of course, on the volume of gas to be handled and is governed by the capacity of the separators. The complete flexibility of the installation adapts it to any condition that may arise and the use of the orifice fittings insures the accurate measurement of whatever amount of gas may have to pass through the line leading from the separator. While incidental to the chief objective of the hook-up, the design as shown in the illustration also saved an appreciable amount of pipe and fittings over other designs made to accomplish the purpose.

The orifice fitting, of course, eliminates the necessity for installing a by-pass around the meter setting and saves the pipe and valves that go to make up the by-pass line. By using a blank plate in the line, the flow can be stoppe at the fitting which then acts as a valve. In the type of orifice fitting shown in the illustrations, one plate is in service in the line while another one is in reserve in an upper chamber. This reserve plate can either be one with an orifice of a size suitable for use with a probable change in volume of flow or can be a blank plate to serve as an emergency valve.

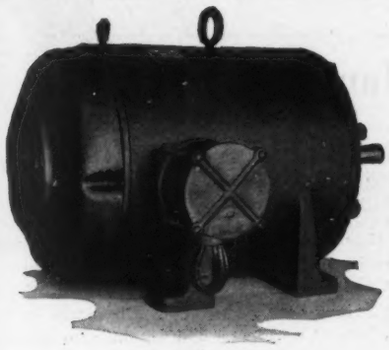
The advantages offered by orifice fittings are now well recognized and their more general use is providing an economy as well as a convenience in operation and a means of securing consistent accuracy in measurement. Orifice fittings are practically a necessity, however, in handling the varying volumes of gas that come from traps where the incoming production is necessarily changed by operating conditions or the hooking-up of new wells.

New Equipment for the Modern Plant

Enclosed, Fan-Cooled Motor

THE IDEAL ELECTRIC & MANUFACTURING COMPANY

The Ideal Electric & Manufacturing Company, Mansfield, Ohio, has developed a new totally-enclosed, fan-cooled motor, claiming all the advantages of dust tight construction and the same size as the ordinary open type motor of same rating.



Ideal Motor

The construction employs two shells—the inner shell being dust tight and enclosing windings and rotor. Tight sealing is obtained by machined metal to metal stationary joints with long close fits—no running seals. A fan mounted outside this shell forces a blast of air between the inner shell and the outer one thereby providing effective cooling.

These motors are made in all sizes from one to 200 horsepower as squirrel cage induction motors to meet all classifications of torque and inrush requirements and with one, two, three or four speeds. They are available also as across-the-line-start motors up to 200 horsepower and can be supplied for power factor correction as 100 per cent or 80 per cent leading power factor induction motors in all sizes.

Recording Meter

TRIMOUNT INSTRUMENT COMPANY

Trimount Instrument Company, 332 South LaSalle Street, Chicago, offers the Flto-Flo Meter for measuring steam production, boiler feed water, distribution of gas, steam and water.

It operates on the principle of the mercury manometer actuated by differential pressure produced by means of an orifice installed in the flow line. The direct method of recording eliminates cams, levers, floats and gears.

When the differential pressure produced by the flow of a fluid through an orifice is applied to a manometer, which is a glass tube in the form of a "U" partially filled with mercury, the mercury will drop in the side of the "U" tube which is connected to the high pressure side of the differential, and rise in that which is connected to the low pressure side. The resulting difference in mercury levels will be directly proportional to the differential pressure as well as to the rate of flow of the liquid through the orifice.

Orifice Peep Flange

REFINERY SUPPLY COMPANY

Refinery Supply Company, 621 East Fourth Street, Tulsa, Oklahoma, announces an orifice peep flange for orifice meters.

The feature of the flange is that the orifice plate may be inspected at any time without touching the flange or removing the plate. Two lenses are built in the flange directly opposite each other at the proper angle, so that they are both directed on the orifice plate. One of the lenses brings light into the flange, while the other offers a direct view of the plate for inspection. (A flashlight should be used for sending a beam of light into the flange through the lense.) The lenses are built to withstand a pressure greater than the flange and are held in place with a cap screwed down on heavy packing.

—Journal Jack—

JOYCE-CRIDLAND COMPANY

The Joyce-Cridland Company, Dayton, Ohio, presents the 35-ton journal jack, suitable for all services where a short, powerful lift is required.

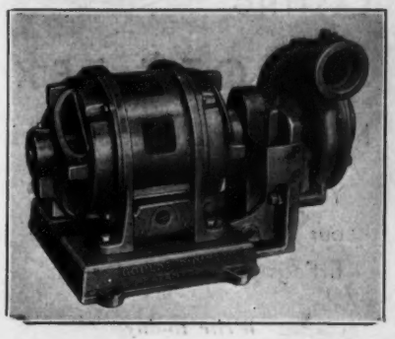
Joyce-Cridland Jack

This jack is especially adapted to lifting of railroad cars, shop locomotives, heavy refinery vessels, tanks, and similar equipment. It is manually operated, has a positive safety stop, enclosed ratchet wheel, and is built without machine screws or bolts.

Pumping Unit

GOULDS PUMPS, INC.

Goulds Pumps, Inc., Seneca Falls, New York, is building a motor-centrifugal pumping unit, which permits the use of standard motors without special bedplates

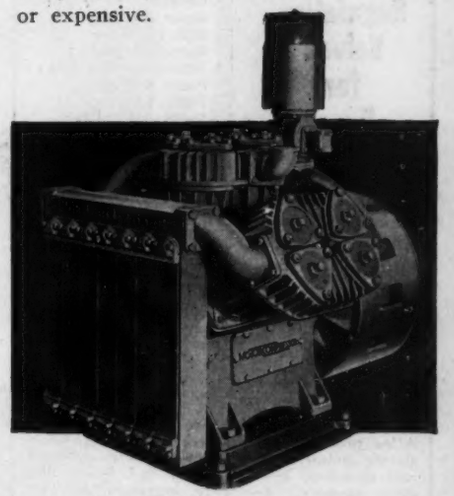


and brackets. Pump bedplate extends under the motor relieving the prime mover of excessive strains. The pumps are built in from three fourths of an inch to four inches.

Compressor

INGERSOLL-RAND COMPANY

Ingersoll-Rand Company, 11 Broadway, New York, has developed an air cooled compressor for use where water is scarce or expensive.



Ingersoll-Rand Compressor

The new machine is called the Motorcompressor and, as the name implies, it has a built-in motor. The motor rotor is carried on the compressor shaft and the motor frame is bolted directly to the compressor crankcase. This construction eliminates a coupling, as well as motor bearings. A rigid sub-base underneath the entire unit makes a compact machine.

The Motorcompressor is a two-cylinder, two-stage machine. Cylinders and intercooler are air cooled. Units are built in sizes from 20 to 50 horsepower, with pis-

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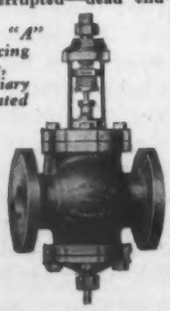

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ton displacements from 113 to 310 cubic feet per minute and for discharge pressures up to 125 pounds gauge. The overall efficiency is equal to or better than in conventional water-cooled compressors of corresponding capacities.

The Motorcompressor is designed to meet the need for an efficient, moderate-size, motor-driven, air-cooled compressor. It can be used for general service or as a standby unit wherever air is required, but is especially suited for locations where water cooling is objectionable or out of the question because of the freezing hazard or for other reasons.

Furnace Draft Regulator

CARRICK ENGINEERING COMPANY

Carrick Engineering Company, Michigan City, Indiana, announces the Carrick Type HF1 Hydraulic Draft Regulator for control of the combustion chamber draft in the boiler plant. The fundamental principle of the regulator is a beam scale. The draft is automatically weighed until the amount of draft for which it has been set is secured, thereafter the draft is automatically and accurately maintained. A bell, suspended from a beam and immersed in an oil seal is the means used to measure the draft.

Items About Manufacturers

The Kron Company, Bridgeport, Connecticut, has appointed the following distributors: Equipment Engineering Company, New Haven, Conn.; R. S. Kerr Company, Atlanta; Equipment Engineering Company, Indianapolis.

C. D. Peterson who has been named divisional manager for the Fisher Governor Company, Marshalltown, Iowa, has arrived in Tulsa and is making arrangements for a home, after which Mrs. Peterson and their two children will arrive.

Mr. Peterson will maintain an office in connection with Smith Separator Company, Fisher representatives for Oklahoma and northern Texas territory. He will, however, travel through the Mid-Continent and Gulf Coast fields in the interest of Automatic control equipment.

Mr. Peterson is a graduate mechanical engineer of Iowa State College. In 1924 he went with Fisher Governor Company and for the past nine years has served as mechanical engineer, handling, design, operation, service, and sales work in connection with the manufacture of automatic control specialties.

C. D. PETERSON

Superheater Company, New York, has bought an interest in and assumed the management of Air Preheater Corporation, Wellsville, N. Y. Air Preheater Corporation will retain its corporate identity and will continue to manufacture Ljungstrom air preheaters in the Wellsville plant. Executive offices, however, have been consolidated with those of Superheater Company at 60 East Forty-Second street, New York. H. S. Colby remains as vice president of Superheater Company.

Officials of the Air Preheater Corporation are: F. A. Schaff, president; H. S. Colby, vice president; M. Schiller, vice president and treasurer;; T. F. Morris, secretary and assistant treasurer; H. S. Marshall, assistant secretary and assistant treasurer. Directors are George L. Bourne, chairman; S. L. Batt, H. S. Colby, R. M. Cates, F. A. Schaff and M. Schiller.

Tnemec Company, Inc., of Kansas City, Missouri, has recently issued a new catalog describing in detail its line of protective and decorative paint coatings for industrial and other purposes. This company has specialized on paints for the petroleum industry.

The Louis Allis Company, Milwaukee, has announced selection of Charles F. Norton in an executive sales capacity. He was formerly vice president and general manager of the Howell Electric Motors Company.

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